DOCUMENT RESUME

ED 459 589 EF 005 991

TITLE	Indoor Air Quality Tools for Schools Action Kit. Second Edition.
INSTITUTION	Environmental Protection Agency, Washington, DC.
SPONS AGENCY	American Federation of Teachers, Washington, DC.; Association of School Business Officials International, Reston, VA.; Council for American Private Education, Washington, DC.; National Education Association, Washington, DC.; National PTA, Chicago, IL.; American Lung Association, New York, NY.
REPORT NO	EPA-402-K-95-001
PUB DATE	2000-00-00
NOTE	170p.; The IAQ road map, asthma companion piece, IAQ Problem-Solving Wheel, and 15-minute videotape not available.
AVAILABLE FROM	U.S. Government Printing Office, Washington, DC ($22). Tel: 202-512-1800. (Order #005-000-00563-0). U.S. EPA, Indoor Environments Division, 1200 Pennsylvania Ave., N.W., Mail Code 6609J, Washington, DC 20460. Tel: 800-438-4318 (Toll Free). For full text: http://www.epa.gov/liaq.schools/tools4s2.html.
PUB TYPE	Guides - Non-Classroom (055)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	*Air Pollution; Elementary Secondary Education; *Guidelines; *Prevention; Program Administration; Public Schools; School Policy
IDENTIFIERS	*Indoor Air Quality

ABSTRACT

This kit contains materials to assist a school indoor air quality (IAQ) coordinator in conducting a school IAQ program. The kit contains the following: IAQ coordinator's guide; IAQ coordinator forms; IAQ backgrounder; teacher's classroom checklist; administrative staff checklist; health officer/school nurse checklist; ventilation checklist and log; building maintenance checklist; food service checklist; waste management checklist; renovation and repairs checklist; and walk through checklist. Also provided is a problem-solving wheel that assists school teachers and others in identifying indoor air problems and correcting them. The kit contains a 15-minute videotape that shows how one school successfully implemented the IAQ Tools for Schools Action Kit to better manage its ventilation system. The videotape explains the importance of good indoor air quality and shows how to properly operate and maintain school ventilation systems. (GR)

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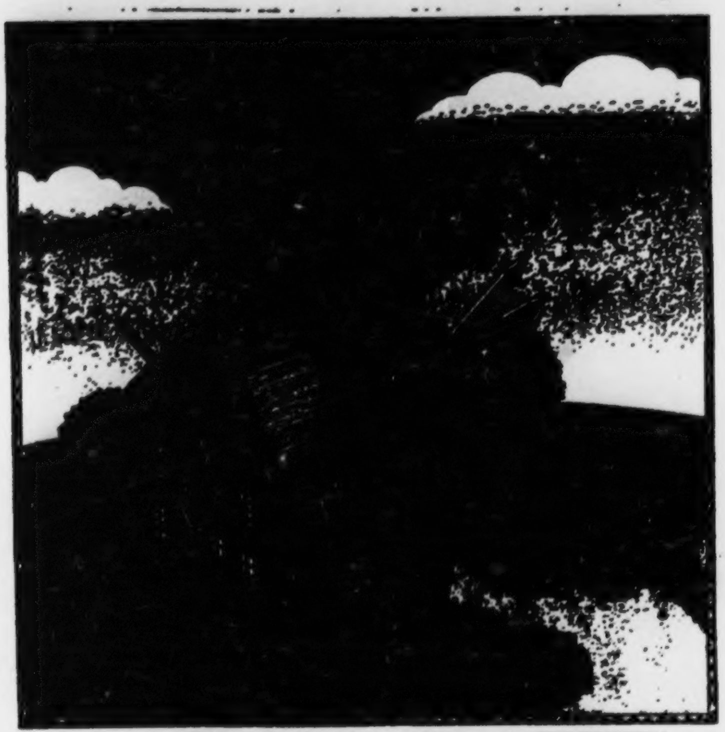

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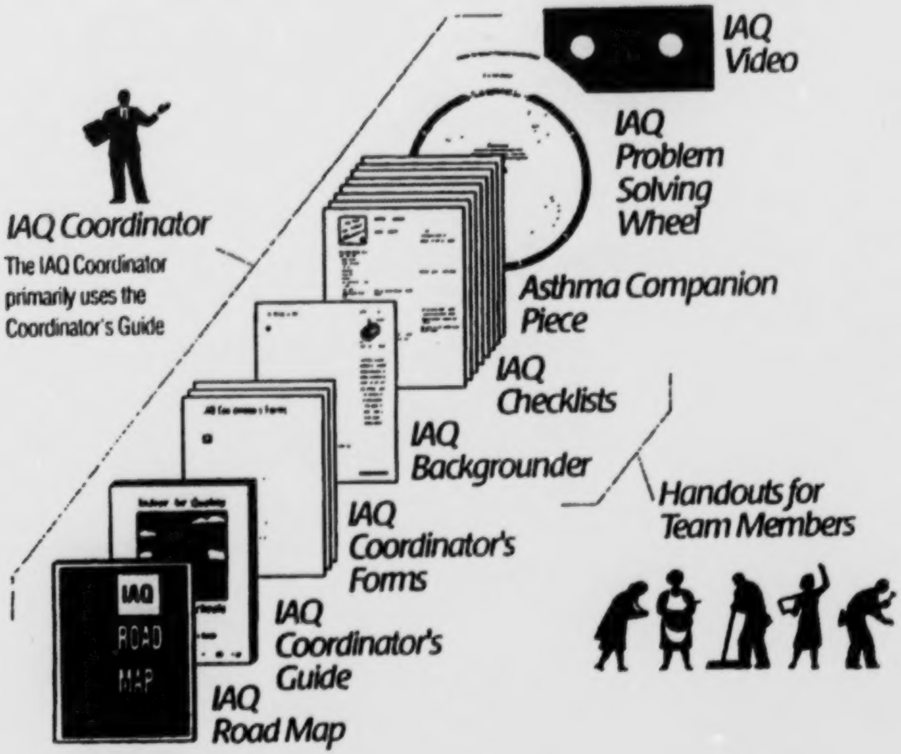

IAQ Video

IAQ Problem Solving Wheel

IAQ Coordinator

The IAQ Coordinator primarily uses the Coordinator's Guide

Asthma Companion Piece

IAQ Checklists

IAQ Backgrounder

Handouts for Team Members

IAQ Coordinator's Forms

IAQ Coordinator's Guide

IAQ Road Map

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Indoor Air Quality

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IAQ Coordinator's Guide

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Indoor Air Quality

Tools for Schools

Note to School Officials and Others Interested in Indoor Air Quality in Schools

Good indoor air quality contributes to a favorable learning environment for students, productivity for teachers and staff, and a sense of comfort, health, and well-being for all school occupants. These combine to assist a school in its core mission–educating children.

Rising energy costs encourage the development of tighter buildings and a reduction in the amount of outdoor air brought into schools for ventilation. In addition, school operating and maintenance budgets are often reduced to minimal levels. These actions, combined with the variety of indoor sources of contaminants — building materials, furnishings, cleaning agents, pesticides, printing and copying devices, combustion appliances, tobacco products, allergens, fungi, molds, bacteria, viruses, radon, and lead — can reduce the quality of the indoor environment, and consequently affect the health and well-being of school occupants.

The number of children with asthma increased by 60% during the 1980s, and poor indoor air quality can trigger asthmatic episodes. In addition to myriad health consequences, poor air quality is becoming increasingly costly for schools due to the potential for expensive investigation and hasty solutions during a major indoor air problem, higher heating and cooling costs, damage to the physical building structure and mechanical equipment, and higher liability. For these reasons, air quality in schools is of particular concern. Proper maintenance of indoor air is more than a "quality" issue, it encompasses safety and stewardship of the taxpayer's investment.

In response to this era of tight school budgets, this guidance is designed to allow you to prevent and solve the majority of indoor air problems with minimal cost and involvement. You can accomplish this using current school staff to perform a limited and well-defined set of basic operations and maintenance activities.

The commitment to address indoor air quality (IAQ) starts at the highest level of administration. To be most effective, the school must identify — and the administration must empower — an IAQ Coordinator (page 5). The school should also ensure that all school staff are motivated to carry out the problem-solving and problem prevention guidance provided in this Kit.

As you read this Guide, especially the first six pages, and as school staff progress through program implementation, EPA urges you to maintain a personal involvement in the issue.

This common-sense guidance is designed to help you prevent and solve the majority of indoor air problems with minimal cost and involvement.

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Note: The IAQ Coordinator's Forms, IAQ Backgrounder, IAQ Checklists, and IAQ Problem—Solving Wheel are separate pieces that are supplied with this Guide (see diagram on page 2).

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Acknowledgments

EPA appreciates the time that numerous organizations and individuals took to share ideas, experiences, and comments on the drafts of *Indoor Air Quality Tools for Schools*. Many of these ideas have contributed to the usefulness and completeness of this Kit. Within EPA, project management was provided by Bob Thompson, who developed the concept and much of the content of *Indoor Air Quality Tools for Schools*. The insights and encouragements of Bob Axelrad, Scott Bowles, Sandra Eberle, Elissa Feldman, John Girman, and Dave Mudarri were especially valuable throughout the development of the document. Victoria Drew and Connie Thomas provided exceptional assistance in contract management and editing, and Lisa Adams, Allene Gillam, and Mary Vance are gratefully acknowledged for their office support.

Disclaimer

Any information gathered as a result of using this Kit is for the benefit and use of the local school or school district. EPA does not require retention or submission of any information gathered, and EPA has no regulatory or enforcement authority regarding general indoor air quality in schools. This Kit has been reviewed in accordance with policies of the U.S. Environmental Protection Agency. Information provided is based upon current scientific and technical understanding of the issues presented. Following the advice given will not necessarily provide complete protection in all situations or against all health hazards that may be caused by indoor air pollution. Mention of any trade names or commercial products does not constitute endorsement or recommendation for use.

Warning

Please note the following as you prepare to use this Kit:

- The guidance in this Kit is not intended as a substitute for appropriate emergency action in the event of a hazardous situation that may be immediately threatening to life and safety.
- Modification of building functions, equipment, or structure to remedy air quality complaints may create other indoor air quality problems and may impact life safety systems and energy use. A thorough understanding of all the factors that interact to create indoor air quality problems can help to avoid this undesirable outcome. Consult with professionals if it becomes necessary.
- In the event that medical records are used while evaluating an IAQ problem, confidentiality must be maintained.

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Action Kit Overview

The goal of this Kit is to provide clear and easily applied guidance that will help prevent indoor air quality (IAQ) problems and resolve such problems promptly if they do arise. It recommends practical actions that can be carried out by the school staff without the need for training, and is flexible enough to conform to the specific needs of your school.

The background information and activities in this voluntary program are directed toward existing schools in the kindergarten through twelfth grade range, but colleges, universities, and preschool and day-care centers could benefit by application of the principles and activities presented. In addition, many of these principles could also be applied by architects and engineers when planning new schools or major renovations.

Who Coordinates This Guidance

A team leader, known as the IAQ Coordinator, is needed to fully administer the guidance recommended in this Guide. Please refer to **Section 3**, ***Roles and Functions of the IAQ Coordinator***, for information that will help with selecting an IAQ Coordinator.

Why Follow This Guidance

Section 2, ***Why IAQ Is Important to Your School***, provides information on the benefits of understanding and applying this guidance to maintain good indoor air quality. Three additional reasons to implement this guidance include:

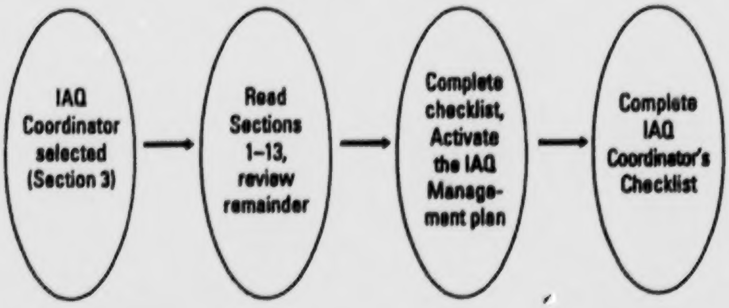
- The expense and effort required to prevent most IAQ problems is much less than the expense and effort required to resolve problems after they develop.
- Many IAQ problems can be prevented by educating school staff and students about the factors that create them. When IAQ problems do arise, they can often be resolved using skills available in-house.
- If outside assistance is needed to solve an IAQ problem, the best results will be achieved if school officials are informed customers.

How This Kit Is Organized

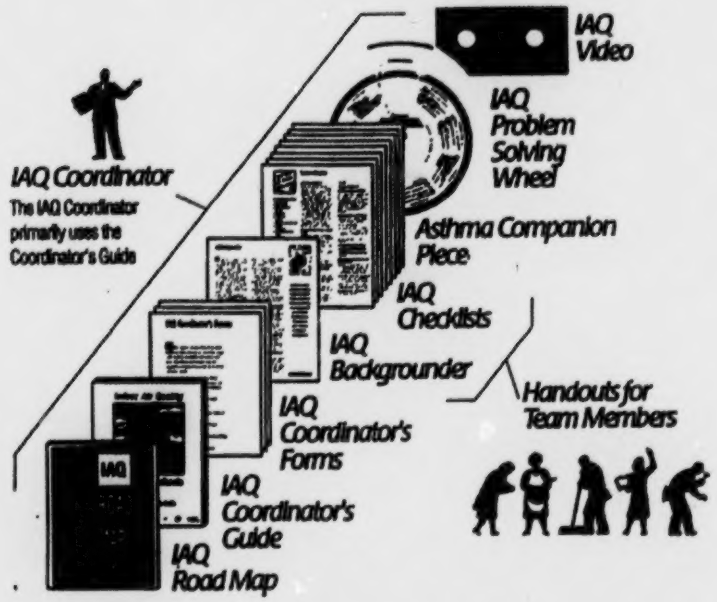
The indoor air quality guidance in this Kit can be divided into two basic categories: background information and specific activities. Once you understand the basic principles and factors that influence indoor air quality in your school, you will note that the specific activities involve two major actions — the management of pollutant sources, and the use of ventilation for pollutant control.

This guidance is organized around the use of an IAQ Team, with the IAQ Coordinator fulfilling leadership and administrative roles, and with the team members each performing specific activities as outlined in **Section 4**.

WHERE THE IAQ COORDINATOR STARTS


IAQ Coordinator selected (Section 3)
Read Sections 1–13, review remainder
Complete checklist, Activate the IAQ Management plan
Complete IAQ Coordinator's Checklist

IAQ Tools for Schools Action Kit


IAQ Video
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Asthma Companion Piece
IAQ Checklists
IAQ Backgrounder
Handouts for Team Members
IAQ Coordinator's Forms
IAQ Coordinator's Guide
IAQ Road Map
IAQ

IAQ TEAM WALKTHROUGH
Look, smell, feel and listen for existing or potential IAQ problems as you tour your school facilities.

TEACHERS
Ensure comfort, health, and reduced sick days for you and your students by preventing IAQ problems in the classroom.

ADMINISTRATIVE STAFF
Show leadership by providing a healthy indoor environment conducive to teaching and learning.

HEALTH OFFICERS
Recognize and monitor trends in reported illnesses that may give early warning of IAQ problems.

FOOD SERVICE STAFF
Reduce odors, moisture, and food waste, thereby lowering the risk of short- or long-term health problems linked to poor indoor air quality.

FACILITIES AND MAINTENANCE STAFF

VENTILATION
Be sure the ventilation system is clean and that an adequate amount of outside air is supplied to the school.

BUILDING MAINTENANCE
Review supplies and follow label instructions; select the safest, most effective products; handle and dispose of supplies safely.

WASTE MANAGMENT
Use proper waste disposal practices to control odors, contaminants, and pests.

RENOVATION AND REPAIRS
During repairs, minimize dust, fumes, and off-gassing from building materials. Avoid designs that interfere with ventilation.

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Why IAQ Is Important to Your School

2

Most people are aware that outdoor air pollution can damage their health but many do not know that indoor air pollution can also have significant health effects. Environmental Protection Agency (EPA) studies of human exposure to air pollutants indicate that indoor levels of pollutants may be 2-5 times, and occasionally more than 100 times, higher than outdoor levels. These levels of indoor air pollutants may be of particular concern because most people spend about 90% of their time indoors. For the purposes of this guidance, the definition of good indoor air quality management includes:

- control of airborne pollutants
- introduction and distribution of adequate outdoor air maintenance of acceptable temperature and relative humidity.

Temperature and humidity cannot be overlooked because thermal comfort concerns underlie many complaints about "poor air quality." Furthermore, temperature and humidity are among the many factors that affect indoor contaminant levels.

Why IAQ Is Important

In recent years, comparative risk studies performed by EPA and its Science Advisory Board have consistently ranked indoor air pollution among the top five environmental risks to public health. Good indoor air quality is an important component of a healthy indoor environment, and can help schools reach their primary goal.

Failure to respond promptly and effectively to IAQ problems can have the following health, cost, and educational process consequences:

- increasing long- and short-term health problems such as cough, eye irritation, headache, asthma episodes, and allergic reactions, and, in rarer cases, life- threatening conditions such as severe asthma attacks, Legionnaire's disease or carbon monoxide poisoning
- promoting the spread of airborne infectious diseases
- aggravating asthma and other respiratory illnesses. Nearly one school-aged child in 13 has asthma, the leading cause of school absenteeism due to chronic disease. There is substantial evidence that indoor environmental exposure to allergens, such as dust mites, other pests, and molds play a role in triggering asthma symptoms. These allergens are found in the school indoor environment
- producing an unfavorable learning environment for children
- reducing productivity of teachers and staff due to discomfort, sickness, or absenteeism
- accelerating the deterioration and thus reducing the efficiency of the school's physical plant and equipment
- increasing the risk that school rooms or buildings will have to be closed, and occupants temporarily relocated
- straining relationships among the school administration and parents and staff
- generating negative publicity that could damage a school's or administration's image and effectiveness
- creating potential liability problems

Good indoor air quality contributes to a favorable learning environment for students, performance of teachers and staff, and a sense of comfort, health, and well-being. These elements combine to assist a school in its core mission — educating children.

Indoor air problems can be subtle, and do not always produce easily recognized impacts on health, well-being, or the physical plant. In some cases, only one or a few individuals may be strongly affected by what appears on the surface to be psychosomatic in nature because the majority of the school population does not appear to have any symptoms.

Children may be especially susceptible to air pollution. The same concentration of pollutants can result in higher body burden in children than adults because children breathe a greater volume of air relative to their body weight. For this and the reasons noted above, air quality in schools is of particular concern. Proper maintenance of indoor air is more than a "quality" issue, it encompasses safety and stewardship of our investment in the students, staff, and facilities.

Unique Aspects of Schools

Unlike other buildings, managing schools involves the combined responsibility for public funds and child safety issues, which can cause strong reactions from concerned parents and the general community. Other unique aspects include:

- occupants are close together, with the typical school having approximately four times as many occupants as office buildings for the same amount of floor space
- budgets are tight, with maintenance often receiving the largest cut during budget reductions
- the presence of a variety of pollutant sources, including art and science supplies, industrial and vocational arts, home economic classes, and gyms
- a large number of heating, ventilating, and air-conditioning systems, placing an added strain on maintenance staff
- as schools add space, the operation and maintenance of each addition is often different
- schools sometimes use rooms, portable classrooms, or buildings which were not originally designed to service the unique requirements of schools

Role and Functions of the IAQ Coordinator

3

IAQ management within schools will not just happen – it requires leadership. Leading people is an important function of the IAQ Coordinator, because it is people who both affect and are affected by the quality of the indoor air. People make decisions – decisions about what materials to bring into the school, how those materials are used, how the school building and ventilation systems are operated, how they are maintained, and how to respond to problems. Effective leadership will ensure that an informed choice is made at each of these decision points.

Functions of the IAQ Coordinator

The primary role of the IAQ Coordinator is team management and leadership. Most of the other work can be shared among IAQ Team members and the rest of the school staff. For example, others can assist with copying and disseminating the Action Packets to the staff, and summarizing responses from the Checklists. The primary IAQ Coordinator functions are:

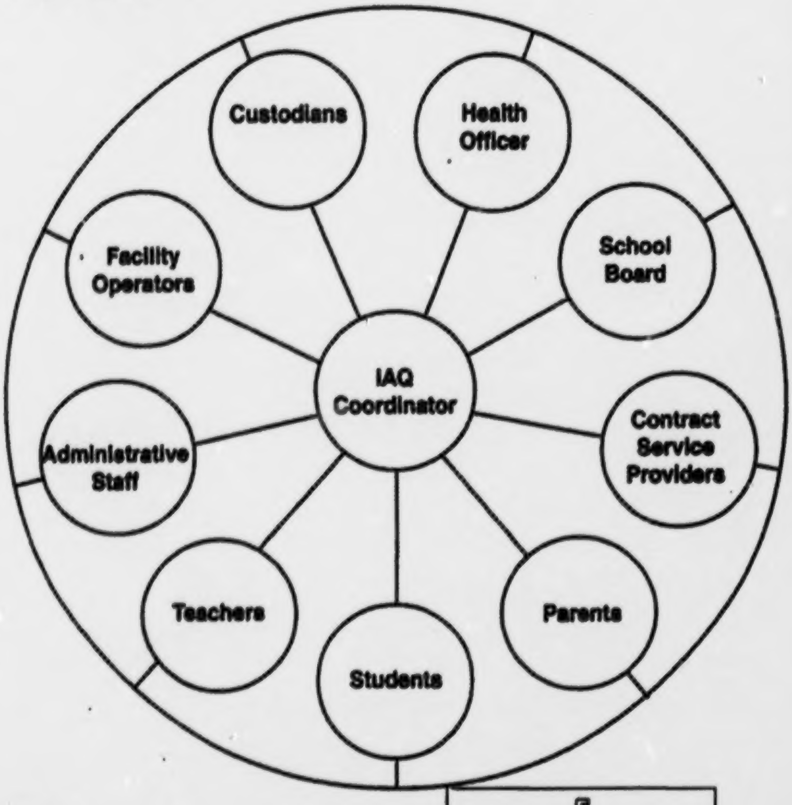
Team Leader: Coordinates an "IAQ Team," as noted in the figure to the right, and encourages a sense of shared responsibility and cooperative effort. Provides the team with the Team Information Packets (Action Packets) supplied in this Kit, and, in coordination with the IAQ Team, implements the IAQ Management Plan (Sections 6-9).

Emergency Response: Prepares for emergency response as outlined in the IAQ Management Plan. Follows the guidance and makes decisions as outlined in *Resolving IAQ Problems* (Sections 10-13). Determines if and when outside professional assistance is needed, and coordinates their activities.

Key Authority: Disseminates IAQ information, registers IAQ complaints and directs the response, and communicates IAQ issues and status to school administration, staff, students, parents, and the press.

Who Is the IAQ Coordinator?

The choice of IAQ Coordinator will probably depend on the organizational structure of your school system. In larger school districts, the IAQ Coordinator may be a district-level administrative person, such as the business official, a health and safety officer, or the facilities manager. In smaller school systems and individual schools, the IAQ Coordinator may be the principal, the school nurse, a teacher, or other school staff.



Who is chosen should be based on the functions and level of leadership needed and genuine interest in improving the indoor environment in the school(s). In any event, success depends on having someone who can manage the team and who is empowered to take action. This includes authority to interact with district-level administration, school staff, students, and parents, and to make budget recommendations. Note– the IAQ Coordinator does not have to be an "expert" in indoor air quality issues. By using this Kit, the IAQ Coordinator and all team members will learn about indoor air quality as the work progresses.

In a few situations, it may become necessary to share the responsibilities of the IAQ Coordinator by having a Co-Coordinator, or by delegating many of the administrative items to a committee, such as an existing health and safety committee. The committee could also be composed of selected individuals from the community, such as local environmental or health department staff, parents, and volunteers from local businesses who have special skills, such as commercial building engineers. Independent of who is acting as the team leader, it is fundamentally important that on a school-by-school basis, the staff and students have the opportunity to learn about the basics of indoor air quality (*IAQ Backgrounder*) so that their daily decisions and activities (IAQ Checklists) will not unnecessarily cause indoor air problems.

Start-Up Hints

In addition to the Coordinator's Forms listed above, there is other information you should gather to make starting an IAQ program easier:

- Get a map/blueprint of the school (this will be invaluable)
- Count the number of staff and their job category, for example, the number of teachers, the number of maintenance staff, etc. (You'll need this information to distribute checklists to staff.)
- Obtain the names and contact information for any outside contractors the school uses, such as maintenance staff, or heating, ventilation, and air-conditioning contractors.

Before starting the program, some IAQ Coordinators have also found it useful to:

- Get support from the school and/or school district administration
- Read the IAQ Coordinator's Guide, especially pages 5-8
- Meet with the heating, ventilation, and air-conditioning technician to acquire a working knowledge of the various ventilation units at your school. Learn which systems serve which rooms.
- Set up a filing system for all the paperwork you will generate. Keep it in a convenient location. (Portable file boxes work nicely.) Set up a location for turning in checklists.
- Set up an IAQ Resource Center at your school in an area where staff members can access information at their leisure. This is also a great place to post important reminders and communicate with your staff when something comes up.

And remember: Implementing an IAQ management program is an on-going process, not an overnight miracle. Be patient. Stay consistent, organized and never forget that you are doing something important for staff and students at your school.

4

Launching the IAQ Team

The IAQ Team

In most schools using this Kit, a committed team works with the IAQ Coordinator to implement the *IAQ Tools for Schools* program. This team, which is led by the IAQ Coordinator, can (and probably should) include representatives from nine distinct groups.

Teachers play a strong role because their decisions and activities can affect the sources of pollutants and levels of ventilation within their room. Some teachers, such as art, science, vocational and industrial arts, and home economics teachers, have unique pollutant sources and ventilation equipment to manage.

Administrative Staff encompasses all administrative and support staff. The staff has control over unique pollutant sources such as printing and kitchen areas, and often controls the operation of the ventilation equipment in their areas.

Facility Operators are the people who have direct technical responsibility for operating and servicing the heating, cooling, and ventilation systems within the school. The role of the facility operator is crucial in preventing and solving IAQ problems.

Custodians and their responsibilities vary widely among school districts. The Building Maintenance Checklist focuses on the housekeeping activities within the school.

Health Officers/School Nurses can be helpful by monitoring and recognizing trends in reported illnesses that may give early warning of IAQ problems.

School Board Representatives can provide the resources and authority necessary to implement an IAQ Management Plan, as outlined in Section 6, and for solving any IAQ problems which may arise, as outlined in Section 12.

Contract Service Providers need to be informed and active members of the IAQ Team because their activities can have a direct and substantial impact on the quality of air within your school. Examples of these activities include pesticide application, renovation work such as re-roofing, and maintenance of ventilation equipment and air filters.

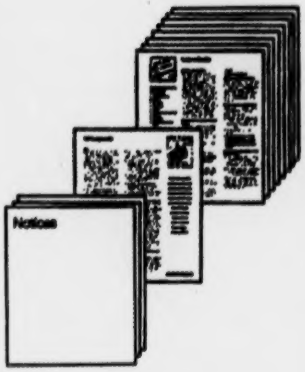
Students are the primary customers in your school. Information should be shared with students so they understand their role in maintaining good IAQ, such as keeping good personal hygiene and keeping lockers clean. In some schools, students have learned about good indoor air quality and then have participated by keeping rooms clean and other activities.

Parents are another important constituent. It is important that they be included and that they be aware of the steps the school is taking to promote good IAQ. Sharing information with parents not only helps avoid miscommunication, but also has the potential of attracting additional resources and expertise to the school.

In addition, each team member may want to read the Coordinator's Guide for more detailed information on IAQ and on the process of using this Kit to prevent, identify and solve IAQ problems in the school.

Available with this Kit is information on how best to "get started" on the *IAQ Tools for Schools* program. Call 1-800-438-4318 and ask for the *IAQ Tools for Schools* Road Map.

IAQ Road Map



Action Packets

Assembling the IAQ Information Packets (Action Packets)

The Action Packets are designed to be useful during the three basic modes of improving a school's IAQ:

- developing a profile of the school's current indoor air quality;
- preventing IAQ problems; and,
- solving any IAQ problems which may arise.

Action Packets should be distributed to the school staff in order to complete the three tasks listed above.

The Action Packets are comprised of three basic components:

School Memo. For school staff, the memo or letter carries the school administration's request that staff members perform the activities as provided in their individual Action Packets. For the school board, contract service provides, students and parents, the memo notifies them that the school has undertaken an IAQ management program, and presents the IAQ Backgrounder. Behind the IAQ Coordinator's Forms tab in the Kit are four sample memos which can be adapted to your needs.

IAQ Backgrounder. This generic backgrounder will provide all team and staff members with a summary of important issues regarding indoor air quality. Issues included are: what is IAQ, why is IAQ important, basic problems and control methods, the team approach, and communications. Graphics are included to assist in understanding the issues.

IAQ Checklists. The IAQ Checklists provide detailed, yet simple, IAQ activities for each staff member. These activities are based on the unique functions and locations of teachers, administrative staff, facility operators, custodians, health officers and school nurses, and contract service providers (e.g., roofers). Each activity deals with a specific pollutant source or ventilation issue. A Checklists Log, located behind the IAQ Coordinator's Forms tab, is provided to assist in summarizing the data from the returned checklists. The Ventilation Checklist also includes a Log for ease of recording the status of each ventilation unit.

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Understanding IAQ Problems

5

Over the past several decades, our exposure to indoor air pollutants has increased due to a variety of factors, including the construction of more tightly sealed buildings, reduced ventilation rates to save energy, the use of synthetic building materials and furnishings, and the use of personal care products, pesticides, and housekeeping supplies. In addition, our activities and decisions, such as deferring maintenance to "save" money, can lead to problems from sources and ventilation.

The indoor environment in any building is a result of the interactions among the site, climate, building structure and mechanical systems (as originally designed and later modified), construction techniques, contaminant sources (what is outside, inside, and part of the building), and building occupants. This section contains a discussion on how these elements can cause IAQ problems, and Section 12 (Solving IAQ Problems) provides solutions. These elements are grouped into four categories:

Sources: there is a source (or sources) of pollution or discomfort indoors, outdoors, or within the mechanical system of the building.

HVAC System: the heating, ventilating, and air conditioning (HVAC) system is not able to control air pollutant levels and/or ensure thermal comfort.

Pathways: one or more pathways connect the pollutant source to the occupants and a driving force exists to move pollutants along the pathway(s).

Occupants: occupant activities have direct impacts on sources, the HVAC system, pathways, and driving forces; and occupants can be carriers of communicable diseases and allergens such as pet dander.

Sources of Indoor Air Pollutants

Indoor air pollutants can originate within the building or be drawn in from outdoors. If pollutant sources are not controlled, IAQ problems can arise, even if the HVAC system is properly designed, operated, and maintained. Air contaminants consist of particles, dust, fibers, bioaerosols, and gases or vapors. It may be helpful to think of air pollutant sources as fitting into one of the categories in the table on the following page, *Typical Sources of Indoor Air Pollutants*. The examples given for each category are not intended to be a complete list. Appendix E contains a list of specific air pollutants, with descriptions, sources, and control measures.

In addition to the number of potential pollutants, another complicating factor is that indoor air pollutant concentration levels can vary by time and location within the school building, or even a single classroom. Pollutants can be emitted from point sources, such as from science storerooms, or from area sources, such as newly painted surfaces. Also, pollutants can vary with time, such as only when floor stripping is done, or continuously such as mold growing in the HVAC system.

Indoor air often contains a variety of contaminants at concentrations that are well below any standards or guidelines for occupational exposure. Given our present knowledge, it is often difficult to relate complaints of specific health effects to exposures to specific pollutant concentrations, especially since the significant exposures may be to low levels of pollutant mixtures.

Interaction of Sources, HVAC Systems, Pathways, and Occupants

If independently evaluated, a minor roof leak and a dirty classroom carpet might not cause much concern. But if the water from the roof leak reaches the carpet, the water can wet the dirt in the carpet and the mold that has been dormant in the carpet. The mold can grow and become a pollutant source that releases spores into the classroom air. The HVAC system acts as a pathway that disperses the spores to other parts of the school, where occupants may experience allergic reactions.

Typical Sources of Indoor Air Pollutants

Outside Sources	Building Equipment	Components/Furnishings	Other Indoor Sources
Polluted Outdoor Air • pollen, dust, mold spores • industrial emissions • vehicle emissions **Nearby Sources** • loading docks • odors from dumpsters • unsanitary debris or building exhausts near outdoor air intakes **Underground Sources** • radon • pesticides • leakage from underground storage tanks	**HVAC Equipment** • mold growth in drip pans, ductwork, coils, and humidifiers • improper venting of combustion products • dust or debris in ductwork **Non-HVAC Equipment** • emissions from office equipment (volatile organic compounds, ozone) • emissions from shops, labs, cleaning processes	**Components** • mold growth on soiled or water-damaged materials • dry traps that allow the passage of sewer gas • materials containing volatile organic compounds, inorganic compounds, or damaged asbestos • materials that produce particles (dust) **Furnishings** • emissions from new furnishings and floorings • mold growth on or in soiled or water-damaged furnishings	• science laboratories • vocational arts areas • copy/print areas • food prep areas • smoking lounges • cleaning materials • emissions from trash • pesticides • odors and volatile organic compounds from paint, caulk, adhesives • occupants with communicable diseases • dry-erase markers and similar pens • insects & other pests • personal care products

HVAC System Design and Operation

The HVAC system includes all heating, cooling, and ventilating equipment serving a school: boilers or furnaces, chillers, cooling towers, air handling units, exhaust fans, ductwork, and filters. A properly designed and functioning HVAC system:

- controls temperature and relative humidity to provide thermal comfort
- distributes adequate amounts of outdoor air to meet ventilation needs of school occupants
- isolates and removes odors and other contaminants through pressure control, filtration, and exhaust fans

Not all HVAC systems are designed to accomplish all of these functions. Some buildings rely only on natural ventilation. Others lack mechanical cooling equipment, and many function with little or no humidity control. The features of the HVAC system in a given building will depend on:

- age of the design
- climate
- building codes in effect at the time of the design
- budget for the project
- designers' and school districts' individual preferences
- subsequent modifications

Description of HVAC Systems

Two of the most common HVAC designs used in schools are central air handling systems and unit ventilators. Both can perform the same HVAC functions of heating, ventilating, and air-conditioning, but the central air handling unit serves multiple rooms while the unit ventilator serves a single room. With central air handling units, it is important that all rooms served by the central unit have similar thermal and ventilation requirements. If these requirements differ significantly, some rooms may be too hot, too cold, or underventilated, while others are comfortable and adequately ventilated.

Most air handling units distribute a mixture of outdoor air and recirculated indoor air. HVAC designs may also include units that introduce 100%

outdoor air or that simply recirculate indoor air within the building. Uncontrolled quantities of outdoor air enter buildings by leakage through windows, doors, and gaps in the building exterior. Thermal comfort and ventilation needs are met by supplying "conditioned" air, which is a mixture of outdoor and recirculated air that has been filtered, heated or cooled, and sometimes humidified or dehumidified. The basic components for a central air handling unit and a unit ventilator are shown in the *IAQ Backgrounder*.

Thermal Comfort

A number of variables interact to determine whether people are comfortable with the temperature and relative humidity of the indoor air. The amount of clothing, activity level, age, and physiology of people in schools vary widely, so the thermal comfort requirements vary for each individual. The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 55-1992, describes the temperature and humidity ranges that are comfortable for 80% of people engaged in largely sedentary activities. That information is summarized in the chart below. The ASHRAE standard assumes "normal" indoor clothing. Added layers of clothing reduce the rate of heat loss.

Uniformity of temperature is important to comfort. Rooms that share a common heating and cooling system controlled by a single thermostat may be at different temperatures. Temperature stratification is a common problem caused by convection, the tendency of light, warm air to rise, and heavier, cooler air to sink. If air is not properly mixed by the ventilation system, the temperature near the ceiling can be several degrees warmer or cooler than near the floor, where young children spend much of their time. Even if air is properly mixed, uninsulated floors over unheated spaces can create discomfort in some climate zones. Large fluctuations of indoor temperature can also occur when thermostats have a wide "dead band" (a temperature range in which neither heating or cooling takes place).

Radiant heat transfer may cause people located near very hot or very cold surfaces to be uncomfortable even though the thermostat setting and the measured air temperature are within the comfort range. Schools with large window areas sometimes have acute problems of discomfort due to radiant heat gains and losses, with the locations of complaints shifting during the day as the sun angle changes. Poorly insulated walls can also produce a flow of naturally-convecting air, leading to complaints of draftiness. Closing curtains reduces heating from direct sunlight and reduces occupant exposure to hot or cold window surfaces.

Large schools may have interior ("core") spaces in which year round cooling is required to compensate for heat generated by occupants, office equipment, and lighting, while perimeter rooms may require heating or cooling depending on outdoor conditions.

Humidity is a factor in thermal comfort. Raising relative humidity reduces a person's ability to lose heat through perspiration and evaporation,

All schools need ventilation, which is the process of supplying outdoor air to the occupied areas within the school.

Recommended Ranges of Temperature and Relative Humidity

Relative Humidity	Winter Temperature	Summer Temperature
30%	68.5°F - 75.5°F	74.0°F - 80.0°F
40%	68.0°F - 75.0°F	73.5°F - 80.0°F
50%	68.0°F - 74.5°F	73.0°F - 79.0°F
60%	67.5°F - 74.0°F	73.0°F - 78.5°F

Recommendations apply for persons clothed in typical summer and winter clothing, at light, mainly sedentary, activity.

Source: Adapted from ASHRAE Standard 55-1992, Thermal Environmental Conditions for Human Occupancy so that the effect is similar to raising the temperature. Humidity extremes can also create other IAQ problems. Excessively high or low relative humidities can produce discomfort, high relative humidities can promote the growth of mold and mildew, and low relative humidities can accelerate the release of spores into the air. (See **Appendix H**).

Selected Outdoor Air Ventilation Recommendations (Minimum)

Application	CFM per Person
Classroom	15
Music Rooms	15
Libraries	15
Auditoriums	15
Spectator Sport Areas	15
Playing Floors	20
Office Space	20
Conference Rooms	20
Smoking Lounges	60
Cafeteria	20
Kitchen (cooking)	15

Source: ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality

Ventilation For Occupant Needs

All schools need ventilation, which is the process of supplying outdoor air to the occupied areas in the school. As outdoor air is drawn into the school, indoor air is exhausted by fans or allowed to escape through openings, thus removing indoor air pollutants. Often, this exhaust air is taken from areas that produce air pollutants such as restrooms, kitchens, science-storage closets, and fume hoods.

Modern schools generally use mechanical ventilation systems to introduce outdoor air during occupied periods, but some schools use only natural ventilation or exhaust fans to remove odors and contaminants. In naturally ventilated buildings, unacceptable indoor air quality is particularly likely when occupants keep the windows closed because of extreme hot or cold outdoor temperatures. Even when windows and doors are open, under ventilation is likely when air movement forces are weakest, such as when there is little wind, or when there is little temperature difference between inside and outside (stack effect).

The amount of outdoor air considered adequate for proper ventilation has varied substantially over time. Because updating building codes often takes several years, the building code, if any, that was in force when your school HVAC system was designed, may well have required a lower amount of ventilation than what is currently considered adequate. ASHRAE ventilation standards are used as the basis for most building ventilation codes. A table of outdoor air quantities in schools as recommended by ASHRAE Standard 62-1989, *Ventilation for Acceptable Indoor Air Quality*, is shown to the left. Please note that this is a limited portion of the Standard, and that the quantities listed are in units of CFM/person, which is cubic feet per minute of outdoor air for each person in the area served by that ventilation system.

Pollutant Pathways and Driving Forces

Airflow patterns in buildings result from the combined action of mechanical ventilation systems, human activity, and natural forces. Differences in air pressure created by these forces move airborne pollutants from areas of higher pressure to areas of lower pressure through any available openings. An inflated balloon is an example of this driving force. As long as the opening to the balloon is kept shut, no air will flow, but when open, air will move from inside (area of higher pressure) to the outside (area of lower pressure). Even if the opening is small, air will move until the pressures inside and outside are equal.

If present, the HVAC ducts are generally the predominant pathway and driving force for air movement in buildings. However, all of a building's components (walls, ceilings, floors, doors, windows, HVAC equipment, and occupants) interact to affect how air movement distributes pollutants within a building.

For example, as air moves from supply outlets to return inlets, it is diverted or obstructed by walls and furnishings, and redirected by openings that provide pathways for air movement. On a localized basis, the movements of people have a major impact on the movement of pollutants. Some of the pathways change as doors and windows open and close. It is useful to think of the entire building — the rooms with connecting corridors and utility passageways between them — as part of the air distribution system.

Air movement can transfer emissions from the pollutant source:

- into adjacent rooms or spaces that are under lower pressure
- into other spaces through HVAC system ducts
- from lower to upper levels in multi-story schools
- transport of pollutants into the building through either infiltration of outdoor air or reentry of exhaust air
- to various points within the room

Natural forces exert an important influence on air movement between a school's interior and exterior. Both the stack effect and wind can overpower a building's HVAC system and disrupt air circulation and ventilation, especially if the school envelope (walls, ceiling, windows, etc.) is leaky.

Stack effect is the pressure-driven airflow produced by convection, the tendency of warm air to rise. Stack effect exists whenever there is an indoor-outdoor temperature difference, and the effect becomes stronger as the temperature difference increases. Multi-story schools are more affected than single-story schools. As heated air escapes from upper levels, indoor air moves from lower to upper levels, and outdoor air is drawn into the lower levels to replace the air that has escaped. Stack effect can transport contaminants between floors by way of stairwells, elevator shafts, utility chases, and other openings.

Wind effects are transient, creating local areas of high pressure (on the windward side) and low pressure (on the leeward side) of buildings. Depending on the size and location of leakage openings in the building exterior, wind can affect the pressure relationships within and between rooms. Entry of outdoor air contaminants may be intermittent or variable, occurring only when the wind blows from the direction of the pollutant source.

Most public and commercial buildings are designed to be positively pressurized, so that unconditioned air does not enter through openings in the building envelope causing discomfort or air quality problems. The interaction between pollutant pathways and intermittent or variable driving forces can lead to a single source causing IAQ complaints in an area of the school that is distant from the pollutant source.

Building Occupants

The term "building occupants" is generally used in this document to describe the staff, students, and other people who spend extended time periods in the school. Some occupants may be particularly susceptible to the effects of indoor air contaminants:

- individuals with allergies or asthma
- people who may be sensitive to chemicals
- people with a respiratory disease
- people whose immune systems are suppressed due to chemotherapy, radiation therapy, disease, or other causes
- individuals who wear contact lenses

Other groups are particularly vulnerable to exposures of certain pollutants or pollutant mixtures. For example:

- people with heart disease may be more affected by exposure to carbon monoxide than healthy individuals

- children exposed to secondhand tobacco smoke are at higher risk for respiratory illnesses
- people exposed to significant levels of nitrogen dioxide are at higher risk for respiratory infections

Because of varying sensitivity to airborne chemicals and irritants, individuals with heightened sensitivities may react to a particular IAQ problem while surrounding occupants do not display ill effects. Symptoms that are limited to only one or a few persons can also occur when only their area contains the airborne pollutant. In other cases, complaints may be widespread. In addition to different degrees of reaction, an indoor air pollutant or problem can trigger different reactions in different people.

Some occupants may be particularly susceptible to the effects of indoor air contaminants.

The effects of IAQ problems are often non-specific symptoms rather than clearly defined illnesses. Symptoms (which can occur singly or in groups) commonly attributed to IAQ problems include:

- headache, fatigue, and shortness of breath
- sinus congestion, coughing, and sneezing
- eye, nose, throat, and skin irritation
- dizziness and nausea

These symptoms, however, may be caused by other factors, and are not necessarily due to air pollutants.

"Health" and "comfort" are used to describe a spectrum of physical sensations. For example, when the air in a room is slightly too warm for a person's activity, that person may experience mild discomfort. If the temperature rises, discomfort increases and the symptom of fatigue can appear. The person may attribute this fatigue to an unknown air pollutant, rather than to being too warm.

Some complaints by building occupants are based on discomfort. A common IAQ complaint is that "there's a funny smell in here." If occupants think there is an indoor air problem, the slightest odor can trigger concerns over health, even though the cause of that particular odor may not have any effects on health. Environmental stressors such as improper lighting, noise, vibration, poor ergonomics, and psychosocial problems (such as job stress) also can produce symptoms that are similar to those associated with poor air quality.

Sometimes several school occupants become aware of serious health problems (e.g., cancer, miscarriages) over a relatively short time period. Indoor air quality is occasionally blamed for these clusters of health problems, and this can produce tremendous anxiety among school occupants. State or local health departments can provide advice and assistance if clusters are suspected. They may be able to help answer key questions such as, whether the apparent cluster is actually unusual and whether the underlying cause could be related to IAQ.

What Is an IAQ Management Plan?

6

The IAQ Management Plan as presented in this guidance is a set of flexible and specific activities for preventing and resolving IAQ problems. The goals of the IAQ Management Plan as outlined in this document are to:

1. fix any existing IAQ problems
2. instill an IAQ awareness that leads to preventive actions
3. resolve IAQ complaints and incidents as they occur

How the IAQ Management Plan Works

This Kit provides the activities and information needed to prevent and resolve most IAQ problems, and provides checklists to help coordinate the activities. As the IAQ Coordinator, you provide the leadership to manage these activities. The delegation of activities to the IAQ Team members (primarily school staff) helps ensure that people in the school understand their role in preventing and solving IAQ problems. Because no one person is overly burdened, the program is more likely to get started and succeed.

The IAQ Management Plan can be used as presented, or tailored to the specific needs of your school. Because the organizational and physical structures of schools vary, the IAQ Coordinator may choose to make modifications to this recommended process. For example, the IAQ Coordinator may modify some of the steps in the IAQ Management Plan, or may give the *IAQ Backgrounder* and *Teacher's Checklist* to the teachers for their awareness, but may request that some other staff member perform the actual activities for each teacher. Although the administrative process of "who" and "when" is designed to be flexible according to your needs, it is important that all of the individual activities be completed. For additional information on how this Kit is organized, see **Section 1.**

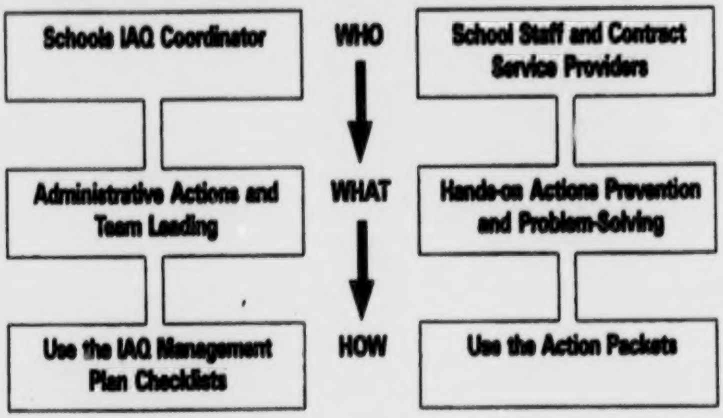
Where to Start

A step-by-step process for activating and implementing the IAQ Management Plan is provided in **Sections 7 and 8**, and checklists to guide and log this process are provided in the IAQ Coordinator's Forms tab of the Kit.

Benefits of an IAQ Management Plan

A well-run IAQ management program yields substantial benefits for the school, employees, and students. In addition to the benefits of health and well-being outlined in **Section 2,** *Why IAQ Is Important to Your School*, the expensive process of investigating and mitigating suspected IAQ problems can be reduced significantly or avoided entirely by employing the plan.

Recommended Approach for Implementing the Plan


Schools IAQ Coordinator
WHO
School Staff and Contract Service Providers
Administrative Actions and Team Leading
WHAT
Hands-on Actions Prevention and Problem-Solving
Use the IAQ Management Plan Checklists
HOW
Use the Action Packets

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A typical school provides many opportunities for IAQ problems to develop. Schools contain a variety of special use areas such as kitchens, locker rooms, science laboratories, technology education rooms, darkrooms, art rooms, and cleaning storage areas, each with pollutant sources that can cause discomfort and health problems. Under detailed inspection, most schools will reveal some inadequacies of design, construction, operation, and maintenance.

Prevention Saves

If minor problems are allowed to develop unchecked into a serious IAQ problem, a variety of deficiencies may be identified, but it often cannot be determined which one — if any — caused the problem. As a result, schools can be confronted with an expensive list of potential explanations of their problem. The crisis atmosphere surrounding a serious IAQ problem creates pressure to remedy every deficiency immediately instead of establishing a prioritized approach to IAQ improvement. By contrast, many of the preventive measures recommended in this guidance can be accomplished with in-house effort, following a schedule that reflects your resources.

Significant IAQ problems often arise from combinations of "normal" defects, rather than from exotic or unique circumstances:

- A school is not getting enough outdoor air because a fan belt is broken or slipping *and* a seldom used drain trap dries out, resulting in sewer gases being drawn into the school
- The design of the school ceiling/roof allows significant air leakage through unintentional openings *and* stack effect (warm air rising) pushes indoor air out through these openings, which causes radon to be drawn into the school through cracks and utility penetrations in the floor
- A housekeeping product is mixed at double the recommended strength so it "does a better job" *and* the unused mix is placed in an inappropriate container *and* stored in a utility closet that is connected to the return air ductwork, which results in pollutants being distributed to other parts of the school

IAQ problems may occur even in schools where a conscientious effort is being made to avoid such problems. However, schools that can demonstrate ongoing efforts to provide a safe indoor environment are in a strong legal and ethical position if problems do arise. Further considerations for instituting an IAQ Management Plan include:

- quicker and more cost-effective response if problems occur
- greater peace of mind for parents, students, and staff
- better comfort, efficiency and durability of the physical plant and equipment
- less crisis intervention which involves upper-level management

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7

Steps to Activate the IAQ Management Plan

To help ensure that the IAQ Management Plan gets off to a good start, the IAQ Coordinator can perform the following 10 steps as presented, or the steps can be tailored to the specific needs of your school. The Checklist, *Activating the IAQ Management Plan*, simplifies tracking completion of these steps.

1. **Select an IAQ Coordinator.** This position is critical to the success of the IAQ Management Plan. If an IAQ Coordinator has not already been selected, please refer to **Section 3**, *Role and Functions of the IAQ Coordinator*, and ensure that the new Coordinator receives a complete copy of this Kit.
2. **Become Familiar with This Guidance.** The IAQ Coordinator should read this Guide to become familiar with the IAQ issues in schools and to have a basic understanding of the IAQ Management Plan process and effective communication.
3. **Gain Top Administrative Support.** The highest levels of school or district administration should be fully committed to implementing the IAQ Management Plan. The top levels of administration have the authority to ensure that the school staff has the proper incentive and resources to carry out the Plan. It may be useful to provide a briefing to the highest levels of school or district administration using information from the *Note to School Officials* **(page I)**, the *IAQ Backgrounder*, and from additional details found in *Why IAQ Is Important to Your School* **(Section 2)**, *What Is an IAQ Management Plan* **(Section 6)**, and *Effective Communication* **(Section 9)**. Most activities in this Plan have specifically been designed to have little or no impact on the school budget and time resources of school staff. Three of the ventilation system activities will require a few tools which your school most likely will need to purchase, rent, or share. See **Appendix C**, *Basic Measurement Equipment*, for information.
4. **Obtain Information on Radon.** Radon is a colorless, odorless, and tasteless radioactive gas that occurs naturally in almost all soil and rock. Radon can enter schools through cracks or other openings in their foundations. Radon's decay products can cause lung cancer, and radon is estimated to be second only to smoking as a cause of lung cancer in America. EPA recommends that all schools test for the presence of radon, and provides free guidance on how to perform testing. For information on how to test for radon, and how to reduce radon within your school, see **Appendix G**, *Radon* and **Appendix I**, *Resources*.
5. **Obtain Information on Integrated Pest Management.** Several of the activities in the Checklists affect the availability of food and water for pests, which may reduce the number of pests within your school. In addition, EPA recommends that schools use Integrated Pest Management (IPM). IPM is an effective and environmentally sensitive approach to pest management that utilizes a combination of common-sense practices. IPM can reduce the use of chemicals and provide eco-

To get information from EPA on radon, see Appendix G, call your State Radon Office, or visit the EPA web site: http://www.epa.gov/iaq/radon

nomical and effective pest suppression. A copy of *Pest Control in the School Environment: Adopting Integrated Pest Management* (EPA 735-F-93-012) is included in this Kit. Contact the National Pesticide Telecommunication Network Hotline (1-800-858-7378) or visit www.ifas.ufl/edu/~schoolipm/ for more information.

6. **Obtain Information on Lead.** Children and pregnant women especially should not be exposed to lead dust particles during renovation or repair of surfaces that are painted with lead-based paint. Lead poisoning can affect children's developing nervous systems, causing reduced IQ and learning disabilities. Guidelines for proper removal are available from OSHA (see **Appendix I**).

7. **Establish an IAQ Checklist Interval.** To help maintain a high level of indoor air quality, it is recommended that the *IAQ Coordinator's Checklist* be completed at least once, and preferably twice, each year. Completing the Checklist more than once each year is desirable, because the additional checkups will catch any new and potential IAQ problems. Since many complaints occur at the start of the new school year, completing the IAQ Coordinator's Checklist shortly before school begins would reduce these complaints. Midway through the school year, for example during winter break, could be an appropriate time for the second checkup.

8. **Establish a Plan for Emergency Response.** Acute IAQ problems such as a chemical spill, unintentional shutdown of ventilation systems, and other events such as a flooded carpet will require some form of immediate response. Preparing for such events now will help ensure that timely and cost-effective actions result. Preparations may include developing a cooperative agreement or contract with a health and safety agency or private contractor to assist with acute IAQ problems that are beyond the capabilities of your team (see **Appendix A,** *Hiring Professional Assistance*). Proper preparation can also mean having the appropriate equipment on hand, for example the equipment needed to immediately clean and dry wet carpets, or having a pre-established agreement with a professional cleaning firm that can provide immediate service on a 24-hour, 7-days-a-week basis.

9. **Inform Appropriate Committees and Groups.** Some of the actions that result from implementing this guidance may need to be coordinated with specific school committees such as a school or school district health and safety committee, or groups such as the local PTA. It may be useful to provide a briefing to these committees and groups that is similar to the briefing in Step 3 above.

10. **Establish IAQ Policies as Needed.** Some activities that affect the quality of air within schools may require clearly written policies from top management to ensure that all school occupants understand how they should or should not perform certain activities. Inappropriate activities include smoking in improperly ventilated areas, pest control by individual occupants, adjustment of ventilation systems by untrained individuals, and maintenance activities such as painting during school hours or by using paints that have lead or high emissions of indoor air pollutants. Sample IAQ policies are provided in **Appendix D.**

The IAQ Management Plan

8

The IAQ Management Plan involves implementing the following 19 steps on a periodic basis, at least once each year. The IAQ Coordinator and Team can perform the steps as presented, or the steps can be tailored to the specific needs of your school. The steps are grouped into three categories: Assess Current Status, Perform Repairs and Upgrades, and Final Steps. Steps 5-7 can begin at the same time as Step 2. A Checklist that simplifies tracking completion of these steps is found in the IAQ Coordinator's Forms tab of the Kit.

Complete the Checklist, *Activating the IAQ Management Plan*, before applying the *IAQ Coordinator's Checklist.*

Assess Current Status

1. **Start the Checklists Log.** This log, found in the IAQ Coordinator's Forms section, is used to list all the people who will receive an Action Packet. A unique Action Packet is provided for each specific group of people within the school (i.e., teachers, administrative staff, facility operators, custodians, health officers, school nurses, contract service providers, and others). The log is also used to keep track of which IAQ Checklists have been returned, and what unresolved IAQ problems, if any, have been identified. **Section 4,** *Launching the IAQ Team*, provides details on who comprises the IAQ Team, descriptions of the Action Packet components, and which Action Packet each team member should receive.

2. **Activate the IAQ Team by Distributing the Action Packets.** Copies of the appropriate Action Packets should be provided to each of the team members as listed on the Checklists Log (Step 1). Each Action Packet contains a cover memo, an *IAQ Backgrounder*, and a Checklist. The Action Packets for parents and local media contain only the memo and *IAQ Backgrounder*. Sample memos are located in the IAQ Coordinator's Forms section. You may wish to introduce the Action Packets and the IAQ Management Plan during a meeting of the school faculty and staff.

3. **Receive and Summarize the IAQ Checklists.** By the closing date noted in the cover memo, all Checklists should be returned to you. You should follow up until all Checklists have been completed and returned, then review the information on the Checklists and transfer pertinent data to the Checklists Log. Make a list of irregularities for review during the walkthrough inspection.

4. **Perform a Walkthrough Inspection.** Based on the new perspective you have gained from the information in this Kit, and from the summary of the Checklists, perform a walkthrough inspection of the school. This is not intended to be an intensive and detailed inspection, but rather a quick overview of the conditions that affect the quality of air within your school. You may wish to have someone who is familiar with the operation of the building, such as a facility operator or custodian, assist you during the inspection.

   During your walkthrough inspection, you can learn a lot by using

Use the new Walkthrough Checklist provided with this Kit for your walkthrough.

your sense of sight, smell, feeling, and hearing to gain information on factors which affect indoor air quality.

- *Observe* the general level of cleanliness in classrooms and mechanical rooms. Look for pollutant sources such as mold, improperly stored chemicals, or excessively dirty air filters and ducts, and look for blocked airflows, such as those caused by books or papers on top of unit ventilators or plywood covering outdoor air intakes.
- ***Smell*** for unique or objectionable odors as you move from room to room.
- ***Feel*** for uncomfortable air temperatures, drafts, and high or low humidity, and feel for air flowing into and out of grilles and air vents.
- *Listen* to the concerns of school occupants regarding IAQ. Do they provide clues to problems such as using their own pest spray to control pests, or turning off the unit ventilator because it is too noisy during class-time? Do you hear unusual equipment noises which may indicate potential problems, and do you hear air blowing out of supply vents?

You can learn a lot by using your sense of sight, smell, feeling and hearing to gain information on factors which affect indoor air quality.

Also, perform a walkthrough inspection in all special-use areas, such as the cafeteria, art rooms, industrial arts areas, and science laboratories. For information on smoking lounges, see **Appendix F.**

5. **Assess Radon Status.** Consider the following questions regarding your current radon status (for specific considerations see the EPA guidance document on radon):

- Has testing for radon been completed?
- If needed, has a radon mitigation system(s) been installed?
- Are all radon mitigation systems operating properly?

6. **Assess Pest Control Program.** Consider the following questions regarding your current pest control program (for specific considerations see the EPA guidance document on Integrated Pest Management):

- Are IPM principles being applied in all areas?
- Are staff using pest control chemicals in accordance with instructions?
- Are only spot-treatments of pesticides used to control obviously infested areas, instead of widespread, indiscriminate application of pesticides?

7. **Assess Lead Status.** Consider the following questions regarding your current lead status (for specific considerations see the EPA guidance document on lead):

- Has lead contamination been assessed in your school?
- Is a lead control or removal program in place?
- Will any upcoming renovation work affect surfaces painted with lead-based paint?

8. **Identify Recent Changes that Affect IAQ.** Consider whether any recent changes to the school building, around the building, to the school schedule or activities, or to occupants, has had an impact on IAQ. Examples include:

- *Has flooding occurred?* Look and smell for mold growth and an increase in IAQ complaints in flooded areas.
- *Have night or weekend classes started?* Check time clock(s) setting on the ventilation system(s) for these class areas.
- *Have new staff been added?* Give them an Action Packet.

Perform Repairs and Upgrades

9. **Set Repair and Upgrade Priorities.** In all likelihood, the Checklists (Step 3) and your walkthrough inspection (Step 4) identified some IAQ problems which have not been corrected. Based on your knowledge of the problem, and your resources of school staff and funding, set repair and upgrade priorities based on your specific needs, and make a to-do list. Include any unresolved problems from previous IAQ Coordinator's Checklists.

   Section 12 provides some ideas on what may be involved in solving the problems (*"Developing Solutions"* and *"Solutions for Other Complaints"*). In addition, **Section 12** also provides basic criteria for determining the practicality of the proposed solutions (*"Evaluating Solutions"*).

10. **Gain Consensus and Approvals.** Because of the potential complexities involved in setting priorities for repairs and upgrades (Step 9 above), and for committing school resources, an agreement from top school management and appropriate committees will probably be necessary.

11. **Distribute Status Report.** Keep school occupants and constituents informed about the general status of IAQ in your school according to the principles of effective communication in **Section 9**.

12. **Perform Repairs and Upgrades.** Ensure that the priorities set in Step 9 are met as the repairs and upgrades are being performed (see **Section 12**, *"Evaluating Solutions"*).

13. **Conduct Follow-up Inspections.** Determine if the repairs and upgrades were performed according to plan or specifications, and determine if the intended results were obtained (see **Section 12**, *Solving IAQ Problems*).

Final Steps

14. **Develop a Schedule of IAQ Events.** It would be very helpful for you, as the IAQ Coordinator, to develop and maintain a schedule of events which may affect IAQ. This could be a separate schedule, but would probably work best if the IAQ events were noted directly on your personal schedule. Following are some examples of IAQ events to note:

- Establish a date for the next round of implementing the IAQ Coordinator's Checklist (see **Section 7**, Step 7, for details).
- If your school is in a humid climate and will be closed-up over the summer, set weekly dates to check for mold growth (sight and smell). Take measures, such as cycling the cooling system, to keep relative humidity below 60% as needed.
- Will there be any renovation or new construction during school time, school breaks, or the summer? If so, mark your schedule with enough lead time so that you can provide Action Packets or other information to the people performing the work.
- Will new school staff be added? If so, mark your schedule to give them appropriate Action Packets so that they can become part of the IAQ Team.

15. **Assess Problem-Solving Performance.** Assess recent problem-solving performance and determine if changes need to be made in your ability to:

- respond to IAQ complaints and incidents quickly

Develop and maintain a schedule of events which may affect IAQ, such as building renovation, major repairs, summer shutdown, and new staff.

- solve IAQ problems, preferably permanently
- communicate in a way that prevents or reduces the concerns of school occupants and constituents during an IAQ problem or crisis

For information on resolving IAQ complaints and incidents, and how to communicate during IAQ problems, use the guidance in **Sections 10 through 13.**

16. **Establish and Update IAQ Policies.** Based on what you have learned during this round of implementing the IAQ Management Plan, does an IAQ policy need to be established to prevent IAQ problems from recurring? Address any existing IAQ policies which are not being properly followed. For information on establishing IAQ policies, see **Appendix D.**

It is important that everyone affected — students, parents, teachers, staff, and administration — receive a report of IAQ issues.

17. **Distribute Summary Report.** It is important that school occupants and constituents, as well as the school administration, receive a report of IAQ issues from this round of the IAQ Management Plan. The Plan is not complete until others know at least the basics of what you know about the status of IAQ in your school. For additional guidance on what to include in the report, see **Sections 9 and 13.**

When reporting to school or district administration, it may be desirable to provide indicators of how successful the IAQ Management Plan has been to date. Indicators may include:

- all IAQ Checklists completed and returned
- all IAQ problems identified by the Checklists corrected
- fewer IAQ complaints
- establishment of good relations with the local media
- school memo and *IAQ Backgrounder* mailed to all parents

18. **Check Contacts List.** Ensure that the contact information is still valid, so that assistance can be quickly obtained if needed.
19. **File Checklists, Reports, and Notes.** For future reference when setting repair priorities or solving persistent problems, and for accountability purposes, it is recommended that all completed paperwork be filed in a readily accessible manner. Files should include:

- Activating the IAQ Management Plan Checklist
- IAQ Coordinator's Checklist
- Checklists from Team members who received an Action Packet
- Checklists Log
- IAQ Problem-Solving Checklist
- Copies of memos, status reports, and final reports
- Copies of communications with school or district administration
- Any personal notes, contracts, or other paperwork as appropriate

Effective Communication

9

Good communication can help prevent indoor air quality problems, and can allay unnecessary fears. Communication can assist school occupants in understanding how their activities affect IAQ, which will enable the occupants to improve their indoor environment through proper choices and actions.

Good communication also involves building rapport with the local media now, before a potentially serious IAQ problem occurs. An informed media that understands your efforts to prevent IAQ problems, and that understands the basics of IAQ in schools, can be an asset instead of a liability during an IAQ crisis.

The following five objectives are important in assuring good communication between you and the school occupants:

1. provide accurate information about factors that are affecting IAQ
2. clarify the responsibilities and activities of the IAQ Coordinator
3. clarify the responsibilities and activities of each occupant
4. notify occupants and parents of planned activities that may affect IAQ
5. employ good listening skills

The Action Packets, forms, and information contained in this Kit will assist you in accomplishing the first three objectives. In addition, refer to the list of communication principles on the next page.

The level of communication is often dependent on the severity of the indoor air quality complaint. If the complaint can be resolved quickly and involves a small number of people (e.g., an annoying but harmless odor from an easily identified source), communication can be handled matter-of-factly like other minor problems without risking confusion and bad feeling among school occupants. Communication becomes a more critical issue when there are delays in identifying and resolving the problem and when serious health concerns are involved.

The fourth objective deals with informing occupants and parents before the start of significant planned activities that produce odors or contaminants. If occupants and parents are uninformed, they may become concerned about unknown air contaminants, such as strange odors or excessive levels of dust, and register an IAQ complaint. Examples of planned activities include pest control, painting, roofing, and new flooring. Notification of planned activities can also prevent problems from arising with students and staff with special needs. For example, an asthmatic student may wish to avoid certain areas within a school, or use alternative classrooms, during times when a major renovation project will produce higher levels of dust. A sample notification letter is provided in the model painting policy in **Appendix D**.

Finally, effective communication also involves effective listening. Listening may provide information that helps prevent problems, and it may help defuse negative reactions by occupants if indoor air problems should occur.

If a tense atmosphere exists due to concerns about current IAQ problems, please refer also to Section 13, "Communication When Problem-Solving."

Once trust and credibility are lost they are almost impossible to regain.

Communication Principles

- ***Be honest, frank, and open.*** Once trust and credibility are lost, they are almost impossible to regain. If you don't know an answer or are uncertain, say so. Admit mistakes. Get back to people with answers. Discuss data uncertainties, strengths, and weaknesses.
- ***Respect your audience.*** If people are sufficiently motivated, they are quite capable of understanding complex information. However, they may not agree with you. Furthermore, no matter how well you communicate, some people will not be satisfied.
- ***Avoid technical language and jargon.*** Minimize and fully explain any necessary technical language. Use concrete images that communicate on a personal level. People in the community are often more concerned about such issues as credibility, competence, fairness, and compassion than about statistics and details.
- ***Employ your best listening skills.*** Take time to find out what people are thinking, rather than assuming that you already know.
- ***Different audiences require different communication strategies.*** Use mass media for providing information, and interpersonal techniques for changing attitudes.
- ***Involve school employees.*** An informed staff is likely to be a supportive staff.
- ***Involve parents.*** Inform parents about what is being done and why, as well as what will happen if problems are detected.
- ***Involve the school board.*** Encourage board members to observe the process (e.g., taking a walkthrough of the school with the IAQ Coordinator).
- ***Emphasize action.*** Always try to include a discussion of actions that are underway or that can be taken.
- ***Encourage feedback.*** Accentuate the positive, and learn from your mistakes.
- ***The goal is an informed public.*** Strive to produce a public that is involved, interested, reasonable, thoughtful, solution-oriented, and collaborative.
- ***Be prepared for questions.*** Provide background material on complex issues. Avoid public conflicts or disagreements between credible sources.
- ***Be responsive.*** Acknowledge the emotions that people express and respond in words and actions. When in doubt, lean toward sharing more information, not less, or people may think you are hiding something.
- ***Combat rumors with facts.*** For example, set up a chalkboard in the teachers' lounge for recording what is heard. Record rumors as they arise, and add responses. Then pass out copies to the staff.
- ***Tell people what you can and cannot do.*** Promise only what you can do and do what you promise.
- ***Work with the media.*** Be accessible to reporters and respect deadlines. Try to establish long-term relationships of trust with specific editors and reporters. Remember that the media are frequently more interested in politics than in science, more interested in simplicity than complexity, more interested in danger than safety.

10

Resolving IAQ Problems

Resolving indoor air quality (IAQ) problems involves diagnosing the cause, applying practical actions that either reduce emissions from pollutant sources or remove pollutants from the air (e.g., increasing ventilation or air cleaning), or both. Causes for problems with sources can stem from improper material selection or application, from allowing conditions that can increase biological contamination and dust accumulation, or from source location. Causes for problems with ventilation stem from improper design, installation, operation, or maintenance of the ventilation system.

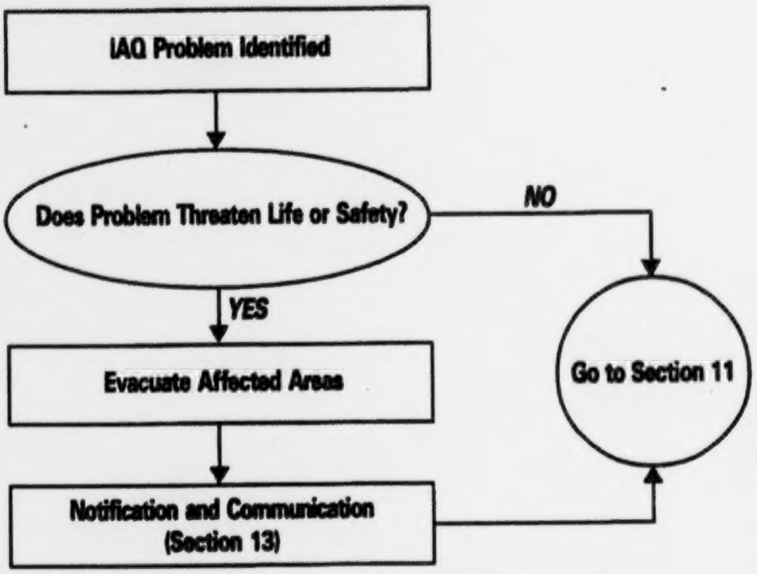
This Kit provides guidance for most IAQ problems found in schools, and does not require that pollutant measurements be performed and analyzed. It is important to take reported IAQ problems seriously and respond quickly because:

- IAQ problems can be a serious health threat and can cause acute discomfort (irritation) or asthma attacks
- Addressing an IAQ problem promptly is good policy. Parents are sensitive to unnecessary delays in resolving problems that affect their children. Staff have enough burdens without experiencing frustration over unresolved problems, and unaddressed problems invariably lead to greater complaints
- Diagnosing a problem is easier immediately after the complaint(s) has been received. The source of the problem may be intermittent and the symptoms may come and go. Also, the complainant's memory of events is best immediately after the problem occurs.

In some cases, people may believe that they are being adversely affected by the indoor air, but the basis for their perception may be some other form of stressor not directly related to indoor air quality. **Section 12** discusses some of these stressors such as glare, noise, and psychosocial factors.

Is This an Emergency?

The first decision that must be made in dealing with an IAQ problem is whether the problem requires an emergency response. Most IAQ problems can be diagnosed and resolved on a short-term, and in some cases even a long-term, basis. But some IAQ incidents require immediate response — high carbon monoxide levels or certain toxic chemical spills will require evacuation of all affected areas in the school, and biological contaminants such as *Legionella* may require a similar response. In recent years, large outbreaks of influenza have caused entire schools and districts


IAQ Problem Identified
Does Problem Threaten Life or Safety?
NO
YES
Evacuate Affected Areas
Go to Section 11
Notification and Communication (Section 13)

to temporarily cease operation. Some schools and districts may already have established policies on what constitutes a life and safety emergency. Local and State health departments can also be helpful in defining life and safety threatening emergencies.

If this is an emergency situation, in addition to immediate action to protect life and health, it is vital that the school administration, parents of students, and appropriate authorities be notified of the situation in a carefully coordinated manner. You must also be prepared to quickly and properly deal with questions from local media. Review the guidance in **Section 13**, *Communication When Problem-Solving*, to assist in managing the issues of notification and communication.

For most problems, a team of in-house staff can be pulled together to solve a problem.

Who Will Solve the Problem?

For most problems, a team of in-house staff, with an appropriate range of skills, can be pulled together to solve a problem. The use of in-house staff builds IAQ knowledge and skills that will be helpful in minimizing and resolving future problems. The Action Packets can teach these skills for typical IAQ problems found in schools. On the other hand, unique or complex IAQ problems may best be handled by professionals who have specialized knowledge, experience, and equipment. Your knowledge of your staff's capabilities will help in deciding whether in-house personnel or outside professionals should be used in responding to the specific IAQ problem.

Regardless of whether it is in-house staff or outside assistance that diagnoses and solves the problem, the IAQ Coordinator remains responsible for managing the problem-solving process, and for communicating as needed with all appropriate parties during the process. If an IAQ Coordinator has not been appointed already, please refer to **Section 3**, *Role and Functions of the IAQ Coordinator*.

11

Diagnosing IAQ Problems

The goal of diagnosing an IAQ problem is to discover the cause of the problem so that an appropriate solution can be implemented. Often, more than one problem will be present, requiring more than one solution. This section presents the Problem-Solving Checklist and the IAQ Problem-Solving Wheel for diagnosing and solving problems. For best results, it is also important to have good background knowledge of the basics of IAQ as outlined in **Sections 2 and 5**.

The IAQ diagnostic process begins when a complaint is registered or an IAQ problem is identified. Many problems can be simple to diagnose, requiring a basic knowledge of IAQ and some common sense. If the cause (or causes) of the IAQ problem has already been identified, proceed to the solution phase outlined in **Section 12**.

Not all occupant complaints about indoor air quality are caused by poor indoor air. Other factors such as noise, lighting, and job-, family-, or peer-related psychosocial stressors can — individually and in combination — contribute to a perception that the indoor air quality is poor.

How to Diagnose Problems

The Problem-Solving Checklist and the IAQ Problem-Solving Wheel are your primary tools for solving problems, and will help simplify the process. They serve to lead the investigation in the right direction and offer suggestions for other areas to evaluate.

Start with the Problem-Solving Checklist, and enlist the assistance of school staff to answer questions or perform activities posed by the Checklist and the Wheel. Consider that pollutant sources and the ventilation system may act in combination to create an IAQ problem.

If the investigation identifies a potential problem (e.g., you find a blocked vent), remedy the situation to see if the symptoms stop. You may find problems unrelated to the symptoms or a number of potential causes. Resolve as many problems as is feasible and make note of any problems that you intend to fix later.

Once the likely cause of the IAQ problem is identified, or if the solution is readily apparent, refer to **Section 12**, *Solving IAQ Problems*, for information on courses of action.

Spatial and Timing Patterns

As a first step, use the spatial pattern (locations) of complaints to try to define the complaint area. School locations where symptoms or discomfort occur define the rooms or zones that should be given particular attention during the investigation. However, the complaint area may need to be revised as the investigation progresses. Pollutant pathways can cause complaints in parts of the school that are far removed from the source of the problems. See the *Spatial Patterns* table on the next page.

After a location or group of locations have been defined, look for patterns in the timing of complaints. The timing of symptoms and complaints can indicate potential causes for the complaints and provide directions for further investigation. Review the data for cyclic patterns of symptoms (e.g., worst during periods of minimum ventilation or when specific sources are most active) that may be related to HVAC system operation or to other activities in and around the school. See the *Timing Patterns* table on the next page.

Spatial Patterns of Complaints	Suggestions
Widespread, no apparent spatial pattern	• Check ventilation and temperature control for entire building • Check outdoor air quality • Review sources that are spread throughout the building (e.g., cleaning materials or microbiological growth inside the ventilation system) • Check for distribution of a source to multiple locations through the ventilation system • Consider explanations other than air contaminants
Localized (e.g., affecting individual rooms, zones, or air handling systems)	• Check ventilation and temperature control within the complaint area • Check outdoor air quality • Review pollutant sources affecting the complaint area • Check local HVAC system components that may be acting as sources or distributors of pollutants
Individual(s)	• Check for drafts, radiant heat (gain or loss), and other localized temperature control or ventilation problems near the affected individual(s) • Consider that common background sources may affect only susceptible individuals • Consider the possibility that individual complaints may have different causes that are not necessarily related to the building (particularly if the symptoms differ among the individuals)

Timing Patterns of Complaints	Suggestions
Symptoms begin and/or are worst at the start of the occupied period	• Review HVAC operating cycles. Pollutants from building materials, or from the HVAC system itself, may build up during unoccupied periods
Symptoms worsen over course of occupied period	• Consider that ventilation may not be adequate to handle routine activities or equipment operation within the building, or that temperature is not properly controlled
Intermittent symptoms	• Look for daily, weekly, or seasonal cycles or weather-related patterns, and check linkage to other events in and around the school
Single event of symptoms	• Consider spills, other unrepeated events as sources
Symptoms relieved on leaving the school, either immediately, overnight, or (in some cases) after extended periods away from the building	• Consider that the problem may be building-associated, though not necessarily due to air quality. Other stressors (e.g., lighting, noise) may be involved
Symptoms never relieved, even after extended absence from school (e.g., vacations)	• Consider that the problem may not be building-related

Solving IAQ Problems

12

The purpose of this section is to provide an understanding of basic principles in solving IAQ problems. This guidance can be helpful in selecting a mitigation strategy, and in evaluating the practicality and effectiveness of proposals from in-house staff or outside professionals.

Developing Solutions

Selection of a solution is based on the data gathered during diagnostics (**Section 11**). The diagnostics may have determined that the problem was either a real or a perceived IAQ problem, or combination of multiple problems. For each problem that the diagnostics identify, develop a solution using the basic control strategies described below.

There are six basic control methods for lowering concentrations of indoor air pollutants. Often only a slight shift in emphasis or action using these control methods is needed to more effectively control indoor air quality. Specific applications of these basic control strategies can be found in each team member's Checklist.

Source Management includes source removal, source substitution, and source encapsulation. Source management is the most effective control method when it can be practically applied.

- **Source removal** is very effective. However, policies and actions that keep potential pollutants from entering the school are even better at preventing IAQ problems. Other examples of source removal include, not allowing buses to idle near outdoor air intakes, not placing garbage in rooms where HVAC equipment is located, and banning smoking within the school.
- **Source substitution** includes actions such as selecting a less toxic art material or interior paint than the products which are currently in use.
- **Source encapsulation** involves placing a barrier around the source so that it releases fewer pollutants into the indoor air.

Local Exhaust is very effective in removing point sources of pollutants before they can disperse into the indoor air by exhausting the contaminated air outside. Well known examples where local exhaust is used include restrooms and kitchens. Other examples include science labs and housekeeping storage rooms, printing and duplicating rooms, and vocational/industrial areas such as welding booths.

Ventilation through use of cleaner (outdoor) air to dilute the polluted (indoor) air that people are breathing is often a solution. The ventilation system, when properly designed, operated, and maintained, will automatically take care of "normal" amounts of air pollutants. For emergency situations, such as quick removal of toxic fumes, increased ventilation can be useful, but when considering long-term operating costs, employing "dilution as the solution" is best applied after attempts have been made to reduce the source of the pollutant.

Exposure Control includes adjusting the time, amount, and location of use to reduce exposure.

- **Time of use.** Try not to use a pollutant source when the school is occupied. For example, strip and wax floors on Friday after school is dismissed, so that the floor products have a chance to off-gas over the weekend, reducing the level of pollutants in the air when the school is reoccupied on Monday.

- **Amount of use.** If less of an air polluting source can be used, then less of it will end up in the air.
- **Location of use.** Move the polluting source as far as possible from occupants, or relocate susceptible occupants.

Air Cleaning primarily involves the filtration of particulates from the air as it passes through the HVAC equipment. Gaseous pollutants can also be removed, but these removal systems must be engineered on a case-by-case basis.

If people are provided information ... they can act to reduce their personal exposure.

Education of school occupants regarding IAQ is critical. If people are provided information about the sources and effects of pollutants in their control, and about the proper operation of the ventilation system, they can act to reduce their personal exposure.

Some solutions, such as major ventilation modification, may not be practically implemented due to lack of resources, or due to the need for long periods of non-occupancy so that the work can be safely completed. Employ temporary measures to ensure good IAQ in the meantime.

Solutions for Other Complaints

Specific lighting deficiencies or localized sources of noise or vibration can sometimes be readily identified, and remedial action may be fairly straightforward, such as having more or fewer lights, making adjustments for glare, and relocating, replacing, or acoustically insulating a noise or vibration source. Similarly, some causes of ergonomic or psychosocial stress may be apparent even to an untrained observer.

In other cases, where problems may be more subtle or solutions more complex (such as psychogenic illnesses), enlist the services of a qualified professional.

Remedial actions for lighting, noise, and vibration problems might range from modifications of equipment or furnishings to renovation of the building. Ergonomic deficiencies may require furniture or equipment changes or different work practices. The solution to psychosocial problems for school staff may involve new management practices, job redesign, or resolution of underlying labor-management problems.

Evaluating Solutions

To help ensure a successful solution, mitigation efforts should be evaluated at the planning stage by considering the following criteria:

- permanence
- durability
- operating principle
- installation & operating cost
- control capacity
- ability to institutionalize the solution
- conformity with codes

Permanence. Mitigation efforts that create permanent solutions to indoor air problems are clearly superior to those that provide temporary solutions, unless the problems are also temporary. Opening windows or running air handlers on full outdoor air may be suitable mitigation strategies for a temporary problem such as off-gassing of volatile compounds from new furnishings, but are not acceptable permanent solutions due to increased costs for energy and maintenance. A permanent solution to microbiological contamination involves not only cleaning and disinfection, but also moisture control to prevent regrowth.

Durability. IAQ solutions that are durable are more attractive than approaches that require frequent maintenance or specialized skills. New items of equipment should be quiet, energy-efficient, and durable.

Operating Principle. The most economical and successful solutions to IAQ problems are those in which the operating principle of the correction strategy makes sense and is suited to the problem. If a specific point source of contaminants has been identified, treatment at the source by removal, sealing, or local exhaust is almost always a more appropriate correction strategy than dilution of the contaminant by increased general ventilation. If the IAQ problem is caused by the introduction of outdoor air that contains contaminants, then increasing the outdoor air supply will only make the situation worse, unless the outdoor air being supplied is cleaned.

Installation and Operating Costs. The approach with the lowest initial cost may not be the least expensive over the long run. Long-term economic considerations include: energy costs for equipment operation, increased staff time for maintenance, differential cost of alternative materials and supplies, and higher hourly rates if odor-producing activities such as cleaning must be scheduled for unoccupied periods.

Control Capacity. It is important to select a solution whose size and scope fits the problem. If odors from a special use area such as a kitchen are causing complaints in nearby classrooms, increasing the ventilation rate in the classrooms may not be successful. If mechanical equipment is needed to correct the IAQ problem, it must be powerful enough to accomplish the task. For example, a local exhaust system should be strong enough and close enough to the source so that none of the contaminant moves into other portions of the building.

Ability to Institutionalize the Solution. A solution will be most successful when it is institutionalized as part of normal building operations. Solutions that do not require exotic equipment are more likely to be successful in the long run than approaches that involve unfamiliar concepts or delicately maintained systems. If maintenance or housekeeping procedures or supplies must change as part of the solution, it may be necessary to provide additional training, new inspection checklists, or modified purchasing guidelines. Operating and maintenance schedules for heating, cooling, and ventilation equipment may also need modification.

A solution will be most successful when it is institutionalized as part of normal building operations.

Conformity with Codes. Any modification to building components or mechanical systems should be designed and installed in conformance with applicable fire, electrical, and other building codes.

Evaluating the Effectiveness of Your Solution

Two kinds of indicators can be used to evaluate the success of an effort to correct an indoor air problem:

- reduced complaints
- measurement of the properties of the indoor air

Reduction or elimination of complaints appears to be a clear indication of success, but that is not necessarily the case. Occupants who realize that their concerns are being heard may temporarily stop reporting discomfort or health symptoms, even if the actual cause of their complaints has not been corrected. On the other hand, lingering complaints may continue after successful mitigation if people have become upset over the handling of the problem. A smaller number of ongoing complaints may indicate that there were multiple IAQ problems and that one or more problems are still unresolved.

Ongoing complaints may indicate that there were multiple IAQ problems and that one or more problems are still unresolved.

Measurements of airflows, ventilation rates, and air distribution patterns can be used to assess the results of control efforts. Airflow measurements taken during the building investigation can identify areas with poor ventilation; later they can be used to evaluate attempts to improve the ventilation rate, distribution, or direction of flow. Studying air distribution patterns will show whether a mitigation strategy has successfully prevented a pollutant from being transported by airflow. While in some cases the measurement of pollutant levels can be used as a means of determining whether indoor air quality has improved, in many cases this may be difficult and/or prohibitively expensive. Concentrations of indoor air pollutants typically vary greatly over time; further, the specific contaminant measured may not be causing the problem. Measurement of a specific pollutant by a professional is appropriate if the problem was limited to that pollutant. For further information on IAQ measurements, see **Appendix C**.

Persistent Problems

Even the best-planned investigations and mitigation actions may not produce a resolution to the problem. You may have made a careful investigation, found one or more apparent causes for the problem, and implemented a control system. Nonetheless, your correction strategy may not have caused a noticeable reduction in the concentration of the contaminant or improvement in ventilation rates or efficiency. Worse, the complaints may persist even though you have been successful at improving ventilation and controlling all of the contaminants you could identify. When you have pursued source control options and have increased ventilation rates and efficiency to the limits of your expertise, you must decide how important it is to pursue the problem further.

If you have made several unsuccessful efforts to control a problem, then it may be advisable to seek outside assistance. The problem may be fairly complex, and it may occur only intermittently or cross the borders that divide traditional fields of knowledge. It is even possible that poor indoor air quality is not the actual cause of the complaints. Bringing in a new perspective at this point can be very effective. **Appendix A** provides guidance on hiring professional indoor air quality assistance.

13

Communication When Problem-Solving

When a major, and sometimes even minor, IAQ problem occurs, you can be assured that the school community will learn about it quickly. Without open communication, any IAQ problem can become complicated by anxiety, frustration, and distrust. These complications can increase both the time and money needed to resolve the problem.

Immediate communication is vital, and is easiest if a few strategic steps are taken before an IAQ problem arises. First, ensure that a spokesperson is ready by having a working understanding of the communication guidance found in this section and **Section 9**, and a background knowledge of IAQ as outlined in **Sections 2 and 5**. This person should also have complete access to information as the investigation progresses. Because of these qualifications, the IAQ Coordinator may be a good choice for spokesperson. Second, establish a plan for how you will communicate to the school community. The school community includes all occupants of the school, parents, the school district administration and school board, and the local news media.

Paying attention to communication when solving a problem helps to ensure the support and cooperation of school occupants as the problem is investigated and resolved. The basic, yet important, messages to convey are:

- school administration believes it is important to provide a healthy and safe school
- good IAQ is an essential component of a healthful indoor environment
- complaints about IAQ are taken seriously

When a problem arises, communication should begin immediately. You should not wait until an investigation is nearly completed, or until final data are available, before providing some basic elements of information. Communications, whether in conversations or in writing, should include the following elements in a factual and concise manner:

- the general nature of the problem, if it is known, the types of complaints which have been received, and the locations which are affected
- the administration's policy in regard to providing a healthy and safe environment
- what has been done to date to address the problems or complaints, including the types of information that are being gathered
- what is currently being done, including factors that have been evaluated and found not to be causing or contributing to the problem
- how the school community can help
- attempts that are being made to improve IAQ
- work that remains to be done and the expected schedule for its completion
- the name and telephone number of the IAQ Coordinator, who can be contacted for further information or to register complaints

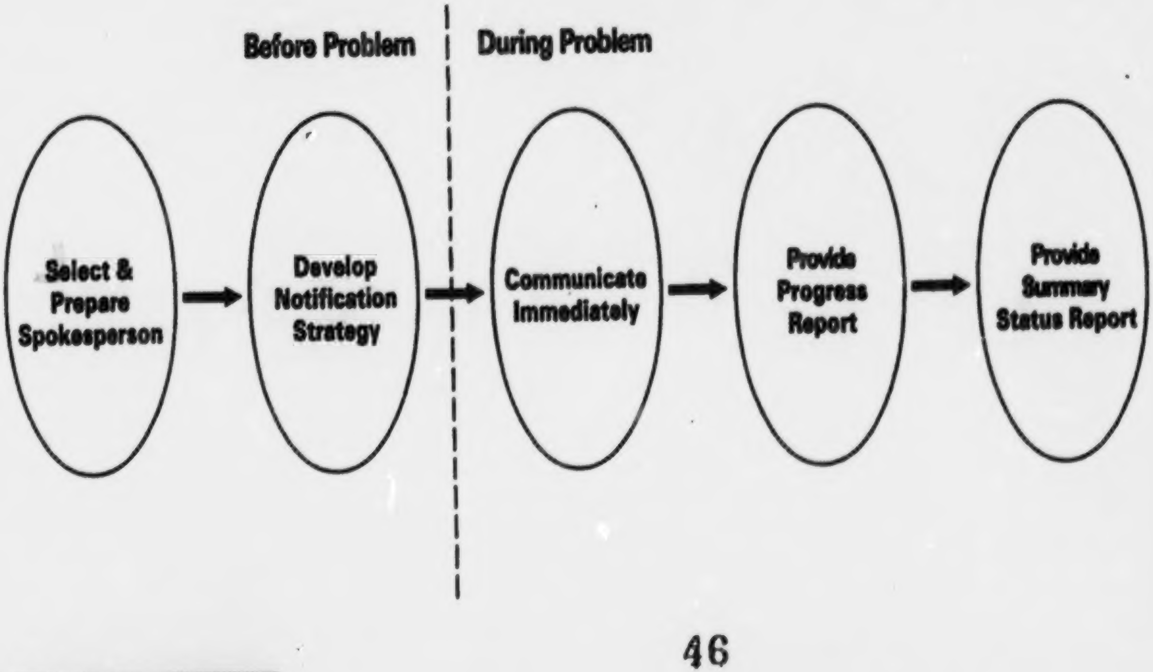
Productive relations will be enhanced if the school community is given basic progress reports during the process of diagnosing and solving problems. It is advisable to explain the nature of investigative activities, so that rumors and suspicions can be countered with factual information. Notices or memoranda can be posted in general use areas and delivered directly to parents, the school board, and other interested constituents of the school community. Newsletter articles or other established communication channels can also be used to keep the school community up-to-date.

Problems can arise from saying either too little or too much. Premature release of information when data-gathering is still incomplete can produce confusion, frustration, and mistrust at a later date. Similar problems can result from incorrect representation of risk — improperly assuming the worst case, or the best.

However, if even simple progress reports are not given, people will think that either nothing is being done, or that something terrible is happening.

Even after the proper mitigation strategy is in place, it may take days or weeks for contaminants to dissipate and symptoms to disappear. If building occupants are informed that their symptoms may persist for some time after solving the problem, the inability to bring instant relief is less likely to be seen as a failure.

Remember to communicate as the final step in problem-solving — although you may know that the problem has been solved, the school community may not know, so be sure to provide a summary status report.


Before Problem
During Problem
Select & Prepare Spokesperson
Develop Notification Strategy
Communicate Immediately
Provide Progress Report
Provide Summary Status Report

Hiring Professional Assistance

Some IAQ problems are simple to resolve when school personnel understand the building investigation process. Many potential problems will be prevented if staff and students do their part to maintain good indoor air quality. However, a time may come when outside assistance is needed. For example, professional help might be necessary or desirable in the following situations:

- If you suspect that you have a serious building-related illness potentially linked to biological contamination in your building, mistakes or delays could have serious consequences (e.g., health hazards, liability exposure, regulatory sanctions). Contact your local or State Health Department.
- Testing for a public health hazard (such as asbestos, lead, or radon) has identified a problem that requires a prompt response.
- The school administration believes that an independent investigation would be better received or more effectively documented than an in-house investigation.
- Investigation and mitigation efforts by school staff have not relieved an IAQ problem.
- Preliminary findings by staff suggest the need for measurements that require specialized equipment and skills that are not available in-house.

Hiring Professional Help:

As you prepare to hire professional services for a building investigation, be aware that indoor air quality is a developing area of knowledge. Most individuals working in IAQ received their primary training in other disciplines. It is important to define the scope of work clearly and discuss any potential consultant's proposed approach to the investigation, including plans for coordinating efforts among team members. The school's representatives must exercise vigilance in overseeing diagnostic activities and corrective action. Performance specifications can help to ensure the desired results. Sample performance specification language is italicized.

Other than for lead and asbestos remediation, there are no Federal regulations covering professional services in the general field of indoor air quality, although some disciplines (e.g., engineers, industrial hygienists) whose practitioners work with IAQ problems have licensing and certification requirements. Individuals and groups that offer services in this evolving field should be questioned closely about their related experience and their proposed approach to your problem. In addition, request and contact references.

Local, State, or Federal government agencies (e.g., education, health, or air pollution agencies) may be able to provide expert assistance or direction in solving IAQ problems. If available government agencies do not have personnel with the appropriate skills to assist in solving your IAQ problem, they may be able to direct you to firms in your area with experience in indoor air quality work. You may also be able to locate potential consultants by looking in the yellow pages (e.g., under "Engineers," "Environmental Services," "Laboratories – Testing," or "Industrial Hygienists"), or by asking other schools for referrals. Often, a multi-disciplinary team of professionals is needed to investigate and resolve an IAQ problem. The skills of HVAC engineers and industrial hygienists are typically useful for this type of investigation. Input from other disciplines such as chemistry, architecture, microbiology, or medicine may also be important. If problems other than indoor air quality are involved, experts in lighting, acoustic design, interior design, psychology, or other fields may be helpful in resolving occupant complaints about the indoor environment.

Evaluating Potential Consultants

As with any hiring process, the better you know your own needs, the easier it will be to select individuals or firms to service those needs. The more clearly you can define the project scope, the more likely you are to achieve the desired result without paying for unnecessary services. An investigation strategy based on evaluating building performance, can be used to solve a problem without necessarily identifying a particular chemical compound as the cause. The idea of testing the air to learn whether it is "safe" or "unsafe" is very appealing. However, most existing standards for airborne pollutants were developed for industrial settings, where the majority of occupants are usually healthy adult men. Some state regulations call for the involvement of a professional engineer for any modifications or additions to a school HVAC system. Whether or not this is legally mandated for your school, the professional engineer's knowledge of air handling, conditioning and sequencing strategies will help to design ventilation system modifications without creating other problems. In some situations, proper engineering can save energy while improving indoor air quality. An example of this might be the redesign of outside air handling strategies to improve the performance of an economizer cycle.

These guidelines may be of assistance in evaluating potential consultants:

1. Competent professionals will ask questions about your situation to see whether they can offer services that will assist you.

   The causes and potential remedies for indoor air quality problems vary greatly. A firm needs at least a preliminary understanding of the facts about what is going on in your building to evaluate if it can offer the professional skills necessary to address your concerns and to make effective use of its personnel from the outset.

2. Consultants should be able to describe how they expect to form and test explanations for and solutions to the problem.

   Discuss the proposed approach to the building investigation. It may involve moving suspected contaminant sources or manipulating HVAC controls to simulate conditions at the time of complaints or to test possible corrective actions. Poorly designed studies may lead to conclusions that are either "false negative" (i.e., falsely concluding that there is no problem) or "false positive" (i.e., falsely concluding that a specific condition caused the complaint).

   Some consultants may produce an inventory of problems in the building without determining which, if any, of those problems caused the original complaint. If investigators discover IAQ problems unrelated to the concern that prompted the evaluation, those problems should be noted and reported. However, it is important that the original complaint is resolved.

3. Decisions to make IAQ measurements should be well-justified.

   A decision to obtain IAQ-related measurements should follow logically from other investigative activities. Before starting to take measurements, investigators need a clear understanding of how the results will be used. Without this understanding, it is impossible to plan appropriate sampling locations and times, instrumentation, and analysis procedures. Non-routine measurements [such as relatively expensive sampling for volatile organic compounds (VOCs)] should not be conducted without site-specific justification.

   Concentrations low enough to comply with industrial occupational standards could still be harmful to children, or other school occupants. Also, industrial IAQ problems tend to arise from high levels of individual chemical compounds, so standards set limits for individual contaminants or contaminant classes. Exposure standards of this type are rarely exceeded in schools. Instead, IAQ investigators often find a large number of potential sources contributing low levels of many contaminants to the air.

4. A qualified IAQ investigator should have appropriate experience, demonstrate a broad understanding of indoor air quality problems and the conditions that can lead to them (e.g., the relationship between IAQ and the building structure, mechanical systems, sources, and human activities), and use a phased diagnostic approach.

   Have the firm identify the personnel who would be responsible for your case, their specific experience, and related qualifications. Contract only for the services of those individuals, or require approval for substitutions. When hiring an engineer, look for someone with the equipment and expertise to carry out a ventilation system assessment, and with a strong background of field experience. Some engineers rarely get out of the office.

5. In the proposal and the interview, a prospective consultant should present a clear, detailed picture of the proposed services and work products, including the following information:

- the basic goal(s), methodology, and sequence of the investigation, the information to be obtained, and the process of hypothesis development and testing, including criteria for decision-making about further data-gathering.
- any elements of the work that will require a time commitment from school staff, including information to be collected by the school.
- the schedule, cost, and work product(s), such as a written report, specifications, and plans for mitigation work; supervision of mitigation work; and training program for school staff.
- additional tasks (and costs) that may be part of solving the IAQ problem but are outside the scope of the contract. Examples include: medical examination of complainants, laboratory fees, and contractor's fees for mitigation work.
- communication between the IAQ professional and the client: How often will the contractor discuss the progress of the work with the school? Who will be notified of test results and other data? Will communications be in writing, by telephone, or face-to-face? Will the consultant meet with students and/or school staff to collect information? Will the consultant meet with staff, parent organizations, or others to discuss findings, if requested to do so?
- references from clients who have received comparable services.

IAQ-Related Ventilation Modifications

The most important thing for the school's representatives to remember is: Oversee the work and ask questions that will help you assure that the work is properly performed. Specialized measurements of air flows or pre- and post-mitigation contaminant concentrations may be needed to know whether the corrective action is functioning properly.

Performance specifications can be used as part of the contract package to establish critical goals for system design and operation. Performance specifications can be used to force contractors to demonstrate that they have met those goals. At the same time, performance specifications should avoid dictating specific design features such as duct sizes and locations, thus leaving HVAC system designers free to apply their professional expertise. You may be able to adapt appropriate sections of the following sample performance specifications for your school.

Performance Specifications

- *The control system shall be modified and the ventilation system repaired and adjusted as needed to provide outdoor air ventilation during occupied hours. The amount of outdoor air ventilation shall meet ASHRAE Standard 62-1989 minimum recommendations, or shall be the maximum possible with the current air handling equipment, but in no case shall the minimum outdoor air ventilation rate be less than the ventilation guideline in effect at the time the school was constructed.*
- *When designing the ventilation system modifications, it is important to ensure that:*
  1) increased outdoor air intake rates do not negatively impact occupant comfort, 2) heating

coils do not freeze, and 3) the cooling system can handle the increased enthalpy load. A load analysis shall be performed to determine if the existing heating (or cooling) plant has the capacity to meet the loads imposed by the restored or increased ventilation rates. If the existing plant cannot meet this load or, if for some other reason, it is decided not to use the existing heating system to condition outdoor air, then a heating (or cooling) plant shall be designed for that purpose. The proposal shall include a life-cycle cost analysis of energy conservation options (e.g., economizer cooling, heat recovery ventilation).

- *All screens in outdoor air intakes shall be inspected for proper mesh size. Screens with mesh size smaller than 1/2 inch are subject to clogging; if present, they shall be removed and replaced with larger-sized mesh (not so large as to allow birds to enter).*

Demonstrating System Performance

- *The proper operation of control sequence and outdoor air damper operation shall be verified by school personnel or the school's agent after ventilation system modifications and repairs have been completed. This shall include, but not be limited to: observation of damper position for differing settings of low limit stats and room stats, measurement of air pressure at room stats and outdoor air damper actuators, direct measurement of air flow through outdoor air intakes, and direct measurement of air flows at exhaust grilles. The contractor shall provide a written report documenting: 1) test procedures used to evaluate ventilation system performance, 2) test locations, 3) HVAC operating conditions during testing, and 4) findings.*

Institutionalizing the Corrective Action

- *After the ventilation system modifications are completed, school facility operators shall be provided with training and two copies of a manual that documents the ventilation system control strategy, operating parameters, and maintenance requirements.*

Codes and Regulations

Pollutant-Related Regulations

The Federal government has a long history of regulating outdoor air quality and the concentrations of airborne contaminants in industrial settings. In an industrial environment, specific chemicals released by industrial processes can be present in high concentrations. It has been possible to study the health effects of industrial exposures and establish regulations to limit those exposures.

Some States have established regulations regarding specific pollutants in schools, such as testing for radon and lead.

Indoor air quality in schools, however, presents a different problem. A large variety of chemicals, used in classrooms, offices, kitchen and cleaning applications, exist at levels that are almost always lower than the concentrations found in industry. The individual and combined effects of these chemicals are very difficult to study, and the people exposed include pregnant women, children, and others who may be more susceptible to health problems than the adult males typically present in regulated industrial settings.

There is still much to learn about the effects of both acute (short-term) and chronic (long-term) exposure to low levels of multiple indoor air contaminants. At this time, there are few Federal regulations for airborne contaminants in non-industrial settings. OSHA (the Occupational Safety and Health Administration) is the Federal agency responsible for workplace safety and health. In the past, OSHA focused primarily on industrial worksites, but most recently has broadened its efforts to address other worksite hazards. In Spring 1994, OSHA introduced a proposed rule regarding IAQ in non-industrial environments. School employees may be able to obtain help (in the form of training and information) from their State OSHA on how to reduce their exposure to potential air contaminants. In States without OSHA organizations, the regional U.S. OSHA contact may be able to provide information or assistance (see *Resources*, **Appendix I**).

Ventilation-Related Regulations

Ventilation is the other major influence on indoor air quality that is subject to regulation. The Federal government does not regulate ventilation in non-industrial settings. However, many State and local governments do regulate ventilation system capacity through their building codes.

Building codes have been developed to promote good construction practices and prevent health and safety hazards. Professional associations such as the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) and the National Fire Protection Association (NFPA) develop recommendations for appropriate building and equipment design and installation (e.g., ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality). Those recommendations acquire the force of law when adopted by State or local regulatory bodies. There is generally a time lag between the adoption of new standards by consensus organizations such as ASHRAE and the incorporation of those new standards as code requirements. Contact your local code enforcement official, your State's Education Department or a consulting engineer to learn about the code requirements that apply to your school.

In general, building code requirements are only enforceable during construction and renovation. When code requirements change over time (as code organizations adapt to new information and technologies), buildings are usually not required to modify their structure or operation to conform to the new codes. Indeed, many buildings do not operate in conformance with current codes, or with the codes they had to meet at the time of construction. For example, the outdoor air flows that ASHRAE's Standard 62 recommends for classrooms were reduced from 30 cfm/person to 10 cfm/person in the 1930's, and reduced again to 5 cfm/person in 1973 in response to higher heating fuel costs resulting from the oil embargo. Concern over indoor air quality stimulated reconsideration of the standard, so that its most recent version, Standard 62-1989, calls for a minimum of 15 cfm/person in classrooms. However, many schools that reduced outdoor air flow during the "energy crisis" continue to operate at ventilation rates of 5 cfm/person or less. This underventilation is contrary to current engineering recommendations, but, in most jurisdictions, it is not against the law.

Basic Measurement Equipment

To prevent or resolve indoor air quality (IAQ) problems effectively and efficiently, you must be able to make four basic measurements relating to the air within the school. Your school or school district may already own some or all of the equipment necessary to make these measurements. If not, it is important to buy or borrow that equipment to accurately assess the IAQ conditions in your school and ensure that the ventilation equipment is working properly (which can save the school money in heating and cooling bills), as well as improve IAQ. Check with your EPA Regional office about equipment availability.

There are four measurements that are important to the activities in this Guide:

- Temperature
- Relative humidity
- Air movement
- Airflow volume

In addition, a CO_2 monitor is useful for indicating when outdoor air ventilation may be inadequate (see the *Ventilation Checklist*).

School management may be nervous about spending money on measurement equipment. This Guide does not recommend sampling for pollutants, which is difficult to interpret and can require costly measurement equipment and significant training and experience. The activities described in this guidance are likely to prevent or uncover problems more effectively than pollutant sampling. The four measurements just listed do not require expensive equipment or special training and are straightforward to interpret. The equipment to measure these four factors is readily available.

If your school's budget does not allow for purchase of some or all of the equipment, try a cooperative approach:

- Combine resources with other schools in the district or neighboring schools
- Contact school organizations and local government to inquire about cooperative purchasing options
- Borrow equipment from another school, district, a State or local government, or an EPA Regional office

Do not let lack of some equipment prevent you from conducting the majority of activities. Conduct all recommended activities possible with the equipment you have available. If you cannot secure resources for obtaining the recommended equipment, prioritize your equipment purchases as follows:

1. Temperature, relative humidity, and chemical smoke device for indicating air movement
2. Airflow volume measuring devices
3. CO_2 monitor

Developing Indoor Air Policies

If there have been problems with staff understanding verbal communication regarding specific activities that affect indoor air quality (IAQ), or if staff follow-through is a problem, a written IAQ policy statement regarding specific IAQ issues may help prevent future problems.

An IAQ policy statement demonstrates a strong commitment by the school administration to address the health and comfort of staff and students, as well as the environmental quality in the school. In addition, an IAQ policy sets an overall direction for efforts to prevent and correct IAQ problems. General issues which may require policies include, but are not limited to: painting; smoking; renovations and repairs; pest management; ventilation system operation; school supply and purchasing; food or pets in the classroom; and disinfectants.

This appendix presents general considerations related to developing an IAQ policy. In addition, it presents three sample IAQ policies targeted to specific indoor pollutant sources. The first sample is a policy on integrated pest management (IPM) developed by EPA. The second sample is a memo on painting, and includes an information letter to parents. The final sample is a nonsmoking policy, including a sample letter to staff. The nonsmoking policy was developed based on a review of model policies from the American Cancer Society, the American Lung Association, and sample policies from various companies and organizations. The samples presented are only intended as guides, and may be modified in any way to meet the site-specific needs and intent of individual schools.

General Considerations

An IAQ policy could include the following components:

- a statement indicating that the school administration is concerned about IAQ and the health, safety, and comfort of staff and students
- a statement indicating that the school administration is committed to preventing and correcting IAQ problems
- authorization of an IAQ Coordinator for each school or district and delegation of authorities to the IAQ Coordinator
- guidance on appropriate steps for maintaining good IAQ (see specific activities in the various IAQ Checklists for ideas)
- guidance on appropriate actions for correcting IAQ problems
- reporting requirements

Developing an IAQ policy should be an open process. A health and safety committee is a good forum for developing consensus recommendations. In the absence of an existing committee, consider establishing an ad hoc committee including administrators, teachers, support personnel, school health officers, maintenance personnel, physicians and community leaders. Interested parents may also wish to serve on this committee.

Sample School Pest Management Policy Statement

When it is determined that a pesticide must be used in order to meet important management goals, the least hazardous material adequate to control the pest will be chosen and label directions shall be followed. The application of pesticides is subject to the Federal Insecticide, Fungicide, and Rodenticide Act (7 United States Code 136 et seq.), school district policies and procedures, Environmental Protection Agency regulations in 40 Code of Federal Regulations, Occupational Safety and Health Administration regulations, and state and local regulations.

Education

Staff, students, pest managers, and the public will be educated about potential school pest problems and the IPM policies and procedures to be used to achieve the desired pest management objectives.

Record Keeping

Records of pesticide use shall be maintained on site to meet the requirements of the state regulatory agency and School Board. Records must be current and accurate if IPM is to work. In addition, pest surveillance data sheets that record the number of pests or other indicators of pest populations are to be maintained to verify the need for treatments.

Notification

This School District takes the responsibility to notify the school staff and parents in advance of pesticide applications.

Pesticide Storage and Purchase

Pesticide purchases will be limited to the amount authorized for use during the year. Pesticides will be stored and disposed of in accordance with the EPA-registered label directions and state regulations. Pesticides must not be accessible to students or unauthorized personnel.

Pesticide Applicators

Pesticide applicators must have a working knowledge of the principles and practices of IPM, and use only pesticides approved by this School District. They must follow regulations and label precautions. Applicators must comply with this School District IPM policy and Pest Management Plan.

Pests and pesticides can pose significant problems and risks to people, property, and the environment. It is therefore the policy of [school name] to incorporate Integrated Pest Management (IPM) procedures for control of structural and landscape pests. This policy will minimize the amount and toxicity of pesticides used in the school.

Continued...

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Pests

Pests are populations of living organisms (animals, plants, or microorganisms) that interfere with use of the school site for human purposes. Strategies for managing pest populations will be influenced by the pest species and whether that species poses a threat to people, property, or the environment.

Pest Management

Approved pest management plans should be developed for the site and should include any proposed pest management measures.

Pests will be managed to:

- Reduce any potential human health hazard or to protect against a significant threat to public safety.
- Prevent loss of or damage to school structures or property.
- Prevent pests from spreading into the community, or to plant and animal populations beyond the site.
- Enhance the quality of life to students, staff, and others.

Integrated Pest Management Procedures

IPM procedures will be used to determine when to control pests and whether to use mechanical, physical, chemical, or biological means. IPM practitioners depend on current, comprehensive information on the pest and its environment and the best available pest control methods. Applying IPM principles prevents unacceptable levels of pest activity and damage by the most economical means and with the least possible hazard to people, property, and the environment.

The decision to use a pesticide will be based on a review of all other available options and a determination that these options are not acceptable or are not feasible. Cost or staffing considerations alone will not be adequate justification for use of chemical control agents, and selected non-chemical pest management methods will be implemented whenever possible to provide the desired control. It is the policy of this School District to utilize IPM principles to manage pest populations adequately. The full range of alternatives, including no action, will be considered.

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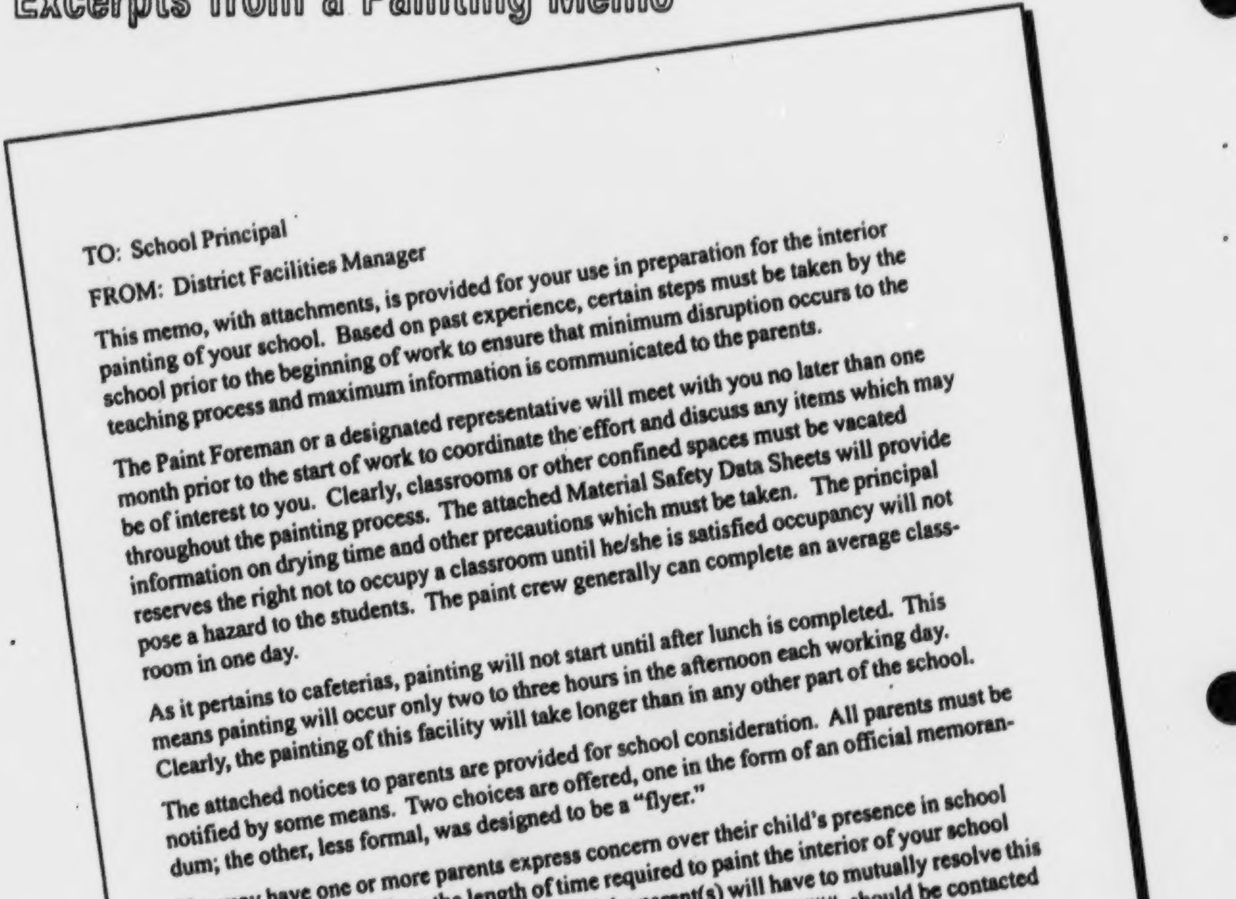
Excerpts from a Painting Memo



TO: School Principal

FROM: District Facilities Manager

This memo, with attachments, is provided for your use in preparation for the interior painting of your school. Based on past experience, certain steps must be taken by the school prior to the beginning of work to ensure that minimum disruption occurs to the teaching process and maximum information is communicated to the parents.

The Paint Foreman or a designated representative will meet with you no later than one month prior to the start of work to coordinate the effort and discuss any items which may be of interest to you. Clearly, classrooms or other confined spaces must be vacated throughout the painting process. The attached Material Safety Data Sheets will provide information on drying time and other precautions which must be taken. The principal reserves the right not to occupy a classroom until he/she is satisfied occupancy will not pose a hazard to the students. The paint crew generally can complete an average classroom in one day.

As it pertains to cafeterias, painting will not start until after lunch is completed. This means painting will occur only two to three hours in the afternoon each working day. Clearly, the painting of this facility will take longer than in any other part of the school.

The attached notices to parents are provided for school consideration. All parents must be notified by some means. Two choices are offered, one in the form of an official memorandum; the other, less formal, was designed to be a "flyer."

You may have one or more parents express concern over their child's presence in school during the painting. Since the length of time required to paint the interior of your school will be a minimum of three months, you and the parent(s) will have to mutually resolve this issue on a case by case basis. The Office of Health Issues, ###-####, should be contacted for assistance if such concerns do arise.

If you have any questions concerning this memo or the painting process, please contact the Paint Department at ###-####, or discuss your questions or concerns at the scheduled prepainting meeting.

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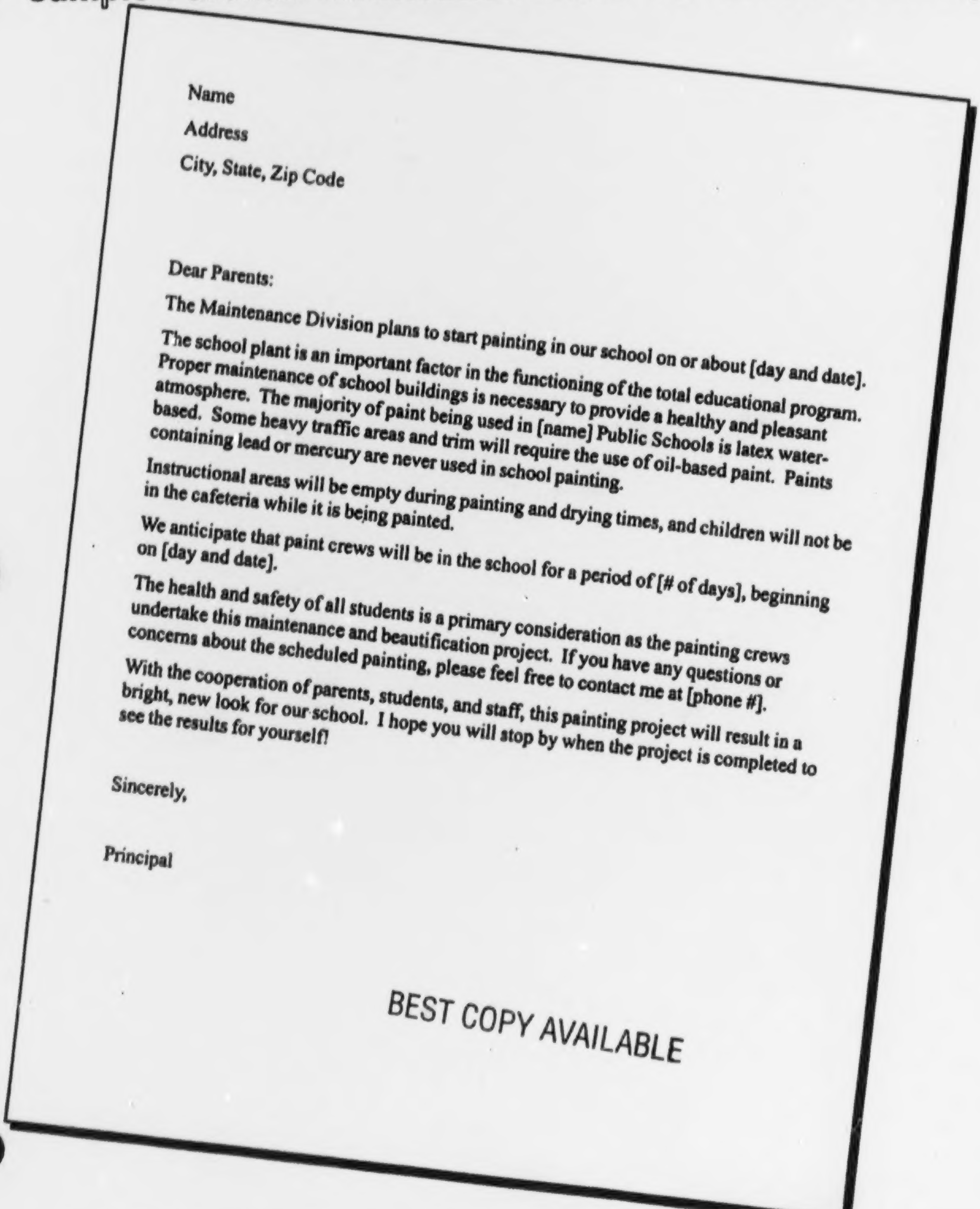
Source: "Indoor Air Quality Management Program," Anne Arundel County Public Schools, Maryland

Sample Parental Notification Letter for School Painting



Name
Address
City, State, Zip Code

Dear Parents:

The Maintenance Division plans to start painting in our school on or about [day and date].

The school plant is an important factor in the functioning of the total educational program. Proper maintenance of school buildings is necessary to provide a healthy and pleasant atmosphere. The majority of paint being used in [name] Public Schools is latex water-based. Some heavy traffic areas and trim will require the use of oil-based paint. Paints containing lead or mercury are never used in school painting.

Instructional areas will be empty during painting and drying times, and children will not be in the cafeteria while it is being painted.

We anticipate that paint crews will be in the school for a period of [# of days], beginning on [day and date].

The health and safety of all students is a primary consideration as the painting crews undertake this maintenance and beautification project. If you have any questions or concerns about the scheduled painting, please feel free to contact me at [phone #].

With the cooperation of parents, students, and staff, this painting project will result in a bright, new look for our school. I hope you will stop by when the project is completed to see the results for yourself!

Sincerely,

Principal

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Source: "Indoor Air Quality Management Program," Anne Arundel County Public Schools, Maryland

Nonsmoking Policies

This section includes a sample announcement policy and sample nonsmoking memo. The announcement letter should address the six main issues covered by the school's nonsmoking policy:

- Explicitly state where smoking is prohibited and permitted (if permitted at all).
- Define individuals who are covered by the policy.
- Clarify exactly what constitutes smoking.
- Outline the stages and dates of policy implementation.
- State the enforcement procedures taken when the policy is violated.
- Identify the appropriate contact for questions and concerns.

The sample policy is intended to provide a framework for developing a nonsmoking policy and highlights issues of particular importance for both large and small schools. The level of detail and specificity of any policy will depend on the type of school, the actions to be taken, and the level of guidance required to effectively communicate the policy to all affected individuals. A simple, clear-cut policy, for example, will require few specifics and will be easily enforced as well.

The nonsmoking policy should be placed in the personnel manual, employee handbook, school by-laws, or another location that will facilitate the distribution of this information to all affected individuals. There are five main issues that should be addressed by the policy:

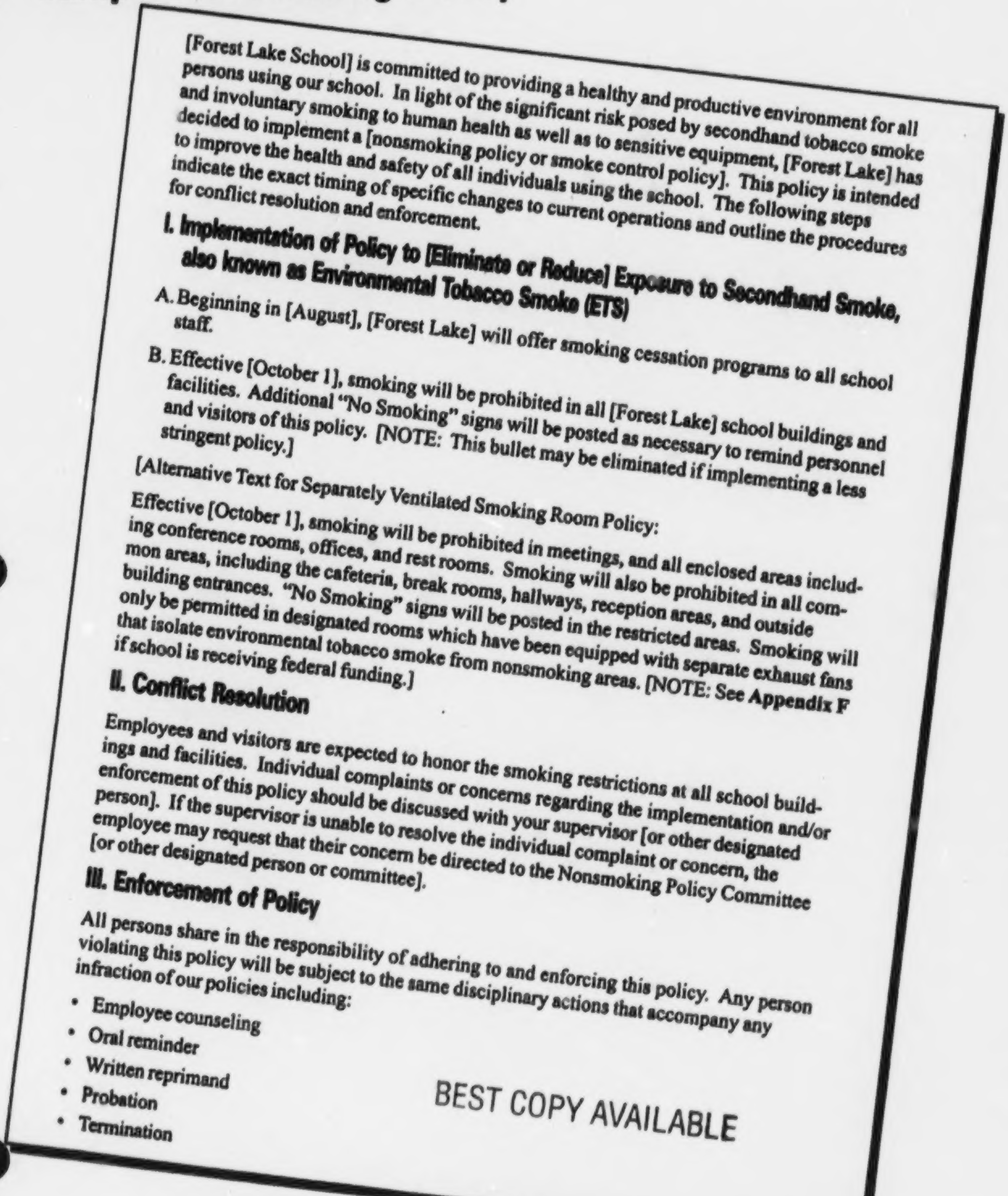
- Why the school is pursuing such a policy.
- What is considered smoking.
- Where and/or when smoking is and is not permitted.
- The procedures for voicing concerns and resolving conflicts.
- The enforcement procedures supporting the implementation of the policy.

The policy may also include information on smoking cessation or other staff education programs being offered or covered by the school.

Following is a sample nonsmoking policy that eliminates smoking indoors. If separately ventilated designated smoking rooms are being provided, this policy can be easily revised by omitting the step about eliminating smoking within the school building. Add more specifics regarding the exact locations where smoking is prohibited and permitted, as well as additional enforcement procedures for potential and repeated infractions.

For additional information on second-hand smoke, see **Appendix F**.

Sample Nonsmoking Policy



[Forest Lake School] is committed to providing a healthy and productive environment for all persons using our school. In light of the significant risk posed by secondhand tobacco smoke and involuntary smoking to human health as well as to sensitive equipment, [Forest Lake] has decided to implement a [nonsmoking policy or smoke control policy]. This policy is intended to improve the health and safety of all individuals using the school. The following steps indicate the exact timing of specific changes to current operations and outline the procedures for conflict resolution and enforcement.

I. Implementation of Policy to [Eliminate or Reduce] Exposure to Secondhand Smoke, also known as Environmental Tobacco Smoke (ETS)

A. Beginning in [August], [Forest Lake] will offer smoking cessation programs to all school staff.

B. Effective [October 1], smoking will be prohibited in all [Forest Lake] school buildings and facilities. Additional "No Smoking" signs will be posted as necessary to remind personnel and visitors of this policy. [NOTE: This bullet may be eliminated if implementing a less stringent policy.]

[Alternative Text for Separately Ventilated Smoking Room Policy:

Effective [October 1], smoking will be prohibited in meetings, and all enclosed areas including conference rooms, offices, and rest rooms. Smoking will also be prohibited in all common areas, including the cafeteria, break rooms, hallways, reception areas, and outside building entrances. "No Smoking" signs will be posted in the restricted areas. Smoking will only be permitted in designated rooms which have been equipped with separate exhaust fans that isolate environmental tobacco smoke from nonsmoking areas. [NOTE: See **Appendix F** if school is receiving federal funding.]

II. Conflict Resolution

Employees and visitors are expected to honor the smoking restrictions at all school buildings and facilities. Individual complaints or concerns regarding the implementation and/or enforcement of this policy should be discussed with your supervisor [or other designated person]. If the supervisor is unable to resolve the individual complaint or concern, the employee may request that their concern be directed to the Nonsmoking Policy Committee [or other designated person or committee].

III. Enforcement of Policy

All persons share in the responsibility of adhering to and enforcing this policy. Any person violating this policy will be subject to the same disciplinary actions that accompany any infraction of our policies including:

- Employee counseling
- Oral reminder
- Written reprimand
- Probation
- Termination

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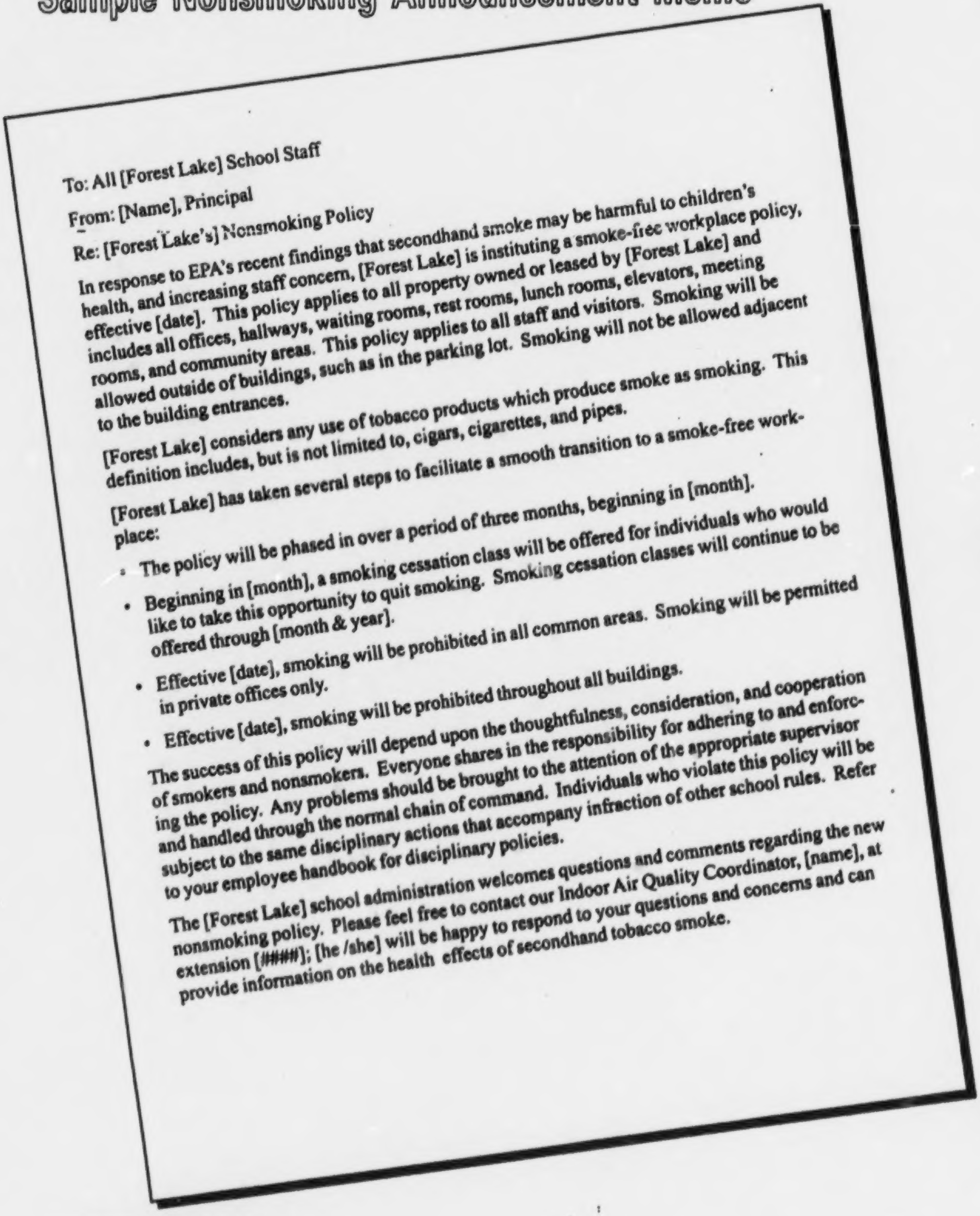
Source: "Indoor Air Quality Management Program," Anne Arundel County Public Schools, Maryland

Sample Nonsmoking Announcement Memo



To: All [Forest Lake] School Staff

From: [Name], Principal

Re: [Forest Lake's] Nonsmoking Policy

In response to EPA's recent findings that secondhand smoke may be harmful to children's health, and increasing staff concern, [Forest Lake] is instituting a smoke-free workplace policy, effective [date]. This policy applies to all property owned or leased by [Forest Lake] and includes all offices, hallways, waiting rooms, rest rooms, lunch rooms, elevators, meeting rooms, and community areas. This policy applies to all staff and visitors. Smoking will be allowed outside of buildings, such as in the parking lot. Smoking will not be allowed adjacent to the building entrances.

[Forest Lake] considers any use of tobacco products which produce smoke as smoking. This definition includes, but is not limited to, cigars, cigarettes, and pipes.

[Forest Lake] has taken several steps to facilitate a smooth transition to a smoke-free workplace:

- The policy will be phased in over a period of three months, beginning in [month].
- Beginning in [month], a smoking cessation class will be offered for individuals who would like to take this opportunity to quit smoking. Smoking cessation classes will continue to be offered through [month & year].
- Effective [date], smoking will be prohibited in all common areas. Smoking will be permitted in private offices only.
- Effective [date], smoking will be prohibited throughout all buildings.

The success of this policy will depend upon the thoughtfulness, consideration, and cooperation of smokers and nonsmokers. Everyone shares in the responsibility for adhering to and enforcing the policy. Any problems should be brought to the attention of the appropriate supervisor and handled through the normal chain of command. Individuals who violate this policy will be subject to the same disciplinary actions that accompany infraction of other school rules. Refer to your employee handbook for disciplinary policies.

The [Forest Lake] school administration welcomes questions and comments regarding the new nonsmoking policy. Please feel free to contact our Indoor Air Quality Coordinator, [name], at extension [####]; [he /she] will be happy to respond to your questions and concerns and can provide information on the health effects of secondhand tobacco smoke.

Typical Indoor Air Pollutants

E

The following four pages present information about several indoor air pollutants common to schools, in a format that allows for easy comparison. The pollutants presented include:

- Biological contaminants (mold, dust mites, pet dander, pollen, etc.)
- Carbon dioxide
- Carbon monoxide
- Dust
- Lead
- Nitrogen oxides
- Other volatile organic compounds (formaldehyde, solvents, cleaning agents)
- Pesticides
- Radon
- Tobacco smoke

Each pollutant is described or analyzed across six categories:

- Description
- Sources
- Standards and guidelines
- Comfort and health effects
- Control measures

Indoor Air Pollutant	Description	Sources
Biological Contaminants	Common biological contaminants include mold, dust mites, pet dander (skin flakes), droppings and body parts from cockroaches, rodents and other pests or insects, viruses, and bacteria. Many of these biological contaminants are small enough to be inhaled.	Biological contaminants are, or are produced by, living things. Biological contaminants are often found in areas that provide food and moisture or water. For example, damp or wet areas such as cooling coils, *humidifiers*, condensate pans, or unvented bathrooms can be moldy. Draperies, bedding, carpet, and other areas where dust collects may accumulate biological contaminants.
Carbon Dioxide	Carbon dioxide (CO_2) is a colorless, odorless product of carbon combustion.	Human metabolic processes and all combustion processes of carbon fuels are sources of CO_2. Exhaled air is usually the largest source of CO_2 in classrooms.
Carbon Monoxide	Carbon monoxide (CO) is a colorless and odorless gas. It results from incomplete oxidation of carbon in combustion processes.	Common sources of CO in schools are from improperly vented furnaces, malfunctioning gas ranges, or exhaust fumes that have been drawn back into the building. Worn or poorly adjusted and maintained combustion devices (e.g. boilers, furnaces) can be significant sources, or a flue that is improperly sized, blocked, disconnected, or leaking. Auto, truck, or bus exhaust from attached garages, nearby roads, or idling vehicles in parking areas can also be a source.
Dust	Dust is made up of particles in the air that settle on surfaces. Large particles settle quickly and can be eliminated or greatly reduced by the body's natural defense mechanisms. Small particles are more likely to be airborne and are capable of passing through the body's defenses and entering the lungs.	Many sources can produce dust including: soil, fleecy surfaces, pollen, lead-based paint, and burning wood, oil or coal.
Environmental Tobacco Smoke (ETS) or Secondhand Smoke	Tobacco smoke consists of solid particles, liquid droplets, vapors and gases resulting from tobacco combustion. Over 4000 specific chemicals have been identified in the particulate and associated gases.	Tobacco product combustion

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Standards or Guidelines	Health Effects	Control Measures
There are currently no federal government standards for biologicals in school indoor air environments (as of 1999).	Mold, dust mites, pet dander, and pest droppings or body parts can trigger asthma. Biological contaminants, including molds and pollens can cause allergic reactions for a significant portion of the population. Tuberculosis, measles, staphylococcus infections, *Legionella* and influenza are known to be transmitted by air.	General good housekeeping, and maintenance of heating and air conditioning equipment, are very important. Adequate ventilation and good air distribution also help. The key to mold control is moisture control. If mold is a problem, clean up the mold and get rid of excess water or moisture. Maintaining the relative humidity between 30% - 60% will help control mold, dust mites, and cockroaches. Employ integrated pest management to control insect and animal allergens. Cooling tower treatment procedures exist to reduce levels of *Legionella* and other organisms.
ASHRAE Standard 62-1989 recommends 1000 ppm as the upper limit for occupied classrooms.	CO_2 is an asphyxiate. At concentrations above 1.5% (15,000 ppm) some loss of mental acuity has been noted. (The recommended ASHRAE standard of 1000 ppm is to prevent body odor levels from being offensive.)	Ventilation with sufficient outdoor air controls CO_2 levels.
The OSHA standard for workers is 50 ppm for 1-hour. NIOSH recommends no more than 35 ppm for 1-hour. The US. National Ambient Air Quality Standards for CO are 9 ppm for 8-hours and 35 ppm for 1-hour. The Consumer Product Safety Commission recommends levels not to exceed 15 ppm for 1-hour or 25 ppm for 8-hours.	CO is an asphyxiate. An accumulation of this gas may result in a varied constellation of symptoms deriving from the compound's affinity for and combination with hemoglobin, forming carboxyhemoglobin (COHb) and disrupting oxygen transport. Tissues with the highest oxygen needs–myocardium, brain, and exercising muscle–are the first affected. Symptoms may mimic influenza and include fatigue, headache, dizziness, nausea and vomiting, cognitive impairment, and tachycardia. At high concentrations CO exposure can be FATAL.	Combustion equipment must be maintained to assure that there are no blockages and air and fuel mixtures must be properly adjusted to ensure more complete combustion. Vehicular use should be carefully managed adjacent to buildings and in vocational programs. Additional ventilation can be used as a temporary measure when high levels of CO are expected for short periods of time.
The EPA Ambient Air Quality standard for particles less than 10 microns is 50 µg/m³ per hour for an annual average and 150 µg/m³ for a 24-hour average.	Health effects vary depending upon the characteristics of the dust and any associated toxic materials. Dust particles may contain lead, pesticide residues, radon, or other toxic materials. Other particles may be irritants or carcinogens (e.g. asbestos).	Keep dust to a minimum with good housekeeping. Consider damp dusting and high efficiency vacuum cleaners. Upgrade filters in ventilation systems to medium efficiency when possible and change frequently. Exhaust combustion appliances to the outside and clean and maintain flues and chimneys. When construction or remodeling is underway, special precautions should be used to separate work areas from occupied areas.
Many office buildings and areas of public assembly have banned smoking indoors, or require specially designated smoking areas with dedicated ventilation systems. The *Pro-Children Act of 1994* prohibits smoking in Head Start facilities, and in kindergarten, elementary and secondary schools that receive federal funding from the Department of Education, the Department of Agriculture, or the Department of Health and Human Services (except Medicare or Medicaid).	The effects of tobacco smoke on smokers include rhinitis/pharyngitis, nasal congestion, persistent cough, conjunctival irritation, headache, wheezing, exacerbation of chronic respiratory conditions. Secondhand smoke has been classified as a "Group A" carcinogen by EPA and has multiple health effects on children. It has also been associated with the onset of asthma, increased severity of, or difficulty in controlling, asthma, frequent upper respiratory infections, persistent middle-ear effusion, snoring, repeated pneumonia, bronchitis.	Smoke outside. Smoke only in rooms which are properly ventilated and exhausted to the outdoors.

Indoor Air Pollutant	Description	Sources
Lead	Lead is a highly toxic metal.	Sources of lead include drinking water, food, contaminated soil and dust, and air. Lead-based paint is a common source of lead dust.
Nitrogen Oxides	The two most prevalent oxides of nitrogen are nitrogen dioxide (NO_2) and nitric oxide (NO). Both are toxic gases with NO_2 being a highly reactive oxidant and corrosive.	The primary sources indoors are combustion processes, such as unvented combustion appliances, e.g. gas stoves, vented appliances with defective installations, welding, and tobacco smoke.
Pesticides	Pesticides are classed as semi-volatile organic compounds and include a variety of chemicals in various forms. Pesticides are chemicals that are used to kill or control pests which include bacteria, fungi, and other organisms, in addition to insects and rodents. Pesticides are inherently toxic.	Pesticides may be applied indoors or can be tracked in from the outdoors.
Radon	Radon is a colorless and odorless radioactive gas, the first decay product of radium-226. It decays into solid alpha particles which can be both inhaled directly or attached to dust particles that are inhaled. The unit of measure for radon is picocuries per liter (pCi/L).	Radium is ubiquitous in the earth's crust in widely varying concentrations. Well water can have high concentrations of radon. Masonry building blocks can have elevated radium concentrations. The principle source, however, is the earth around and under buildings. Radon penetrates cracks and drain openings in foundations, into basements and crawl spaces. Water containing radon will out-gas into spaces when drawn for use indoors. Some building materials will out-gas radon.
Volatile Organic Chemicals (Formaldehyde, Solvents, Cleaning Agents)	Volatile organic chemicals (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors.	VOCs are emitted by a wide array of products numbering in the thousands. Examples include: paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions.

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Standards or Guidelines	Health Effects	Control Measures
The Consumer Product Safety Commission has banned lead in paint.	Lead can cause serious damage to the brain kidneys, nervous system, and red blood cells. Children are particularly vulnerable. Lead exposure in children can result in delays in physical development, lower IQ levels, shorten attention spans, and increase behavioral problems.	Preventive measures to reduce lead exposure include: cleaning play areas; mopping floors and wiping window ledges and other smooth flat areas with damp cloths frequently; keeping children away from areas where paint is chipped, peeling, or chalking; preventing children from chewing on window sills and other painted areas; and ensuring that toys are cleaned frequently and hands are washed before meals.
No standards have been agreed upon for nitrogen oxides in indoor air. ASHRAE and the US. EPA National Ambient Air Quality Standards list 0.053 ppm as the average 24-hour limit for NO_2 in outdoor air.	NO_2 acts mainly as an irritant affecting the mucosa of the eyes, nose, throat, and respiratory tract. Extremely high-dose exposure (as in a building fire) to NO_2 may result in pulmonary edema and diffuse lung injury. Continued exposure to high NO_2 levels can contribute to the development of acute or chronic bronchitis. Low level NO_2 exposure may cause increased bronchial reactivity in some asthmatics, decreased lung function in patients with chronic obstructive pulmonary disease and increased risk of respiratory infections, especially in young children.	Venting the NO_2 sources to the outdoors, and assuring that combustion appliances are correctly installed, used, and maintained are the most effective measures to reduce exposures.
No air concentration standards for pesticides have been set, however, EPA recommends Integrated Pest Management, which minimizes the use of chemical pesticides. Pesticide products must be used according to application and ventilation instructions provided by the manufacturer.	Symptoms may include headache, dizziness, muscular weakness, and nausea. Chronic exposure to some pesticides can result in damage to the liver, kidneys, endocrine and nervous systems.	Use Integrated Pest Management. If chemicals must be used, use only the recommended amounts, mix or dilute pesticides outdoors or in an isolated well ventilated area, apply to unoccupied areas, and dispose of unwanted pesticides safely to minimize exposure.
EPA recommends taking corrective action to mitigate radon if levels are at or exceed 4 pCi/L.	Radon is a known human lung carcinogen. There is evidence of a synergistic effect between cigarette smoking and radon; the risks from exposure to both may exceed the risk from either acting alone.	Active Soil Depressurization and building ventilation are the two most commonly used strategies for controlling radon in schools. Sealing foundations to prevent radon entry as a stand-alone strategy is rarely successful. However, sealing major entry points can improve the effectiveness of other strategies. Increased outdoor air ventilation can reduce radon levels by dilution or pressurization of the building. A ventilation based strategy may not be the most effective strategy if initial radon levels are greater than 10 pCi/L.
No standards have been set for VOCs in non industrial settings. OSHA regulates formaldehyde, a specific VOC, as a carcinogen. OSHA has adopted a Permissible Exposure Level (PEL) of .75 ppm, and an action level of 0.5 ppm. HUD has established a level of .4 ppm for mobile homes. Based upon current information, it is advisable to mitigate formaldehyde that is present at levels higher than 0.1 ppm.	Key signs or symptoms associated with exposure to VOCs include conjunctival irritation, nose and throat discomfort, headache, allergic skin reaction, dyspnea, declines in serum cholinesterase levels, nausea, emesis, epistaxis, fatigue, dizziness.	Increase ventilation when using products that emit VOCs. Meet or exceed any label precautions. Do not store opened containers of unused paints and similar materials within the school. Formaldehyde, one of the best known VOCs, is one of the few indoor air pollutants that can be readily measured. Identify, and if possible, remove the source. If not possible to remove, reduce exposure by using a sealant on all exposed surfaces of paneling and other furnishings. Use integrated pest management techniques to reduce the need for pesticides.

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Secondhand Smoke

Secondhand smoke, also called environmental tobacco smoke (ETS), is a mixture of the smoke given off by the burning end of a cigarette, pipe, or cigar, and the smoke exhaled from the lungs of smokers. This mixture contains more than 4,000 substances, more than 40 of which are known to cause cancer in humans or animals and many of which are strong irritants. Exposure to secondhand smoke is called involuntary smoking, or passive smoking.

EPA has classified secondhand smoke as a known cause of cancer in humans (Group A carcinogen). Passive smoking is estimated to cause 3,000 lung cancer deaths in nonsmokers each year. It also causes irritation of the eyes, nose, throat, and lungs. ETS-induced irritation of the lungs leads to excess phlegm, coughing, chest discomfort, and reduced lung function. Secondhand smoke may also affect the cardiovascular system, and some studies have linked exposure to it with the onset of chest pain.

Secondhand Smoke Effects on Children

Secondhand smoke is a serious health risk to children. Children whose parents smoke are among the most seriously affected by exposure to secondhand smoke, being at increased risk of lower respiratory tract infections such as pneumonia and bronchitis. EPA estimates that passive smoking is responsible for between 150,000 and 300,000 lower respiratory tract infections in infants and children under 18 months of age annually, resulting in between 7,500 and 15,000 hospitalizations per year. Children exposed to secondhand smoke are also more likely to have reduced lung function and symptoms of respiratory irritation like cough, excess phlegm, and wheeze. Passive smoking can lead to a buildup of fluid in the middle ear, the most common cause of hospitalization of children for an operation.

Asthmatic children are especially at risk. EPA estimates that exposure to secondhand smoke increases the number of episodes and severity of symptoms in hundreds of thousands of asthmatic children. EPA estimates that between 200,000 and 1,000,000 asthmatic children have their condition made worse by exposure to secondhand smoke. Passive smoking is also a risk factor for the development of asthma in thousands of children each year.

Recommendations

EPA recommends that every organization dealing with children have a smoking policy that effectively protects children from exposure to secondhand smoke. Parent-Teacher Associations, school board members, and school administrators should work together to make children's school environments smoke free.

Key features of smoking education programs include multiple sessions over many grades, social and physiological consequences of tobacco use, information about social influences (peers, parents, and media), and training in refusal skills. School based non-smoking policies are important because the school environment should be free from secondhand smoke for health reasons and because teachers and staff are role models for children.

Legislation

In general, the Federal government does not have regulatory authority over indoor air or secondhand smoke policies at the State or local level. Restricting smoking in public places is primarily a State and local issue, and is typically addressed in clean indoor air laws enacted by States, counties and municipalities. However, the "Pro-Children Act of 1994" prohibits smoking in Head Start facilities, and in kindergarten, elementary, and secondary schools *that receive federal funding from the Department of Education, the Department of Agriculture, or the Department of Health and Human Services (except funding from Medicare or Medicaid).* The Act was signed into law as part of the "Goals 2000: Educate America Act."

What follows are excerpts from the Act, which took effect December 26, 1994.

Pro-Children Act of 1994

Following are excerpts from Public Law 103-227, March 31, 1994.

SECTION 1042. DEFINITIONS.

(1) CHILDREN. The term "children" means individuals who have not attained the age of 18.

(2) CHILDREN'S SERVICES. The term "children's services" means the provision on a routine or regular basis of health, day care, education, or library services —

(A) that are funded, after the date of the enactment of this Act, directly by the Federal Government or through State or local governments, by Federal grant, loan, loan guarantee, or contract programs —

(i) administered by either the Secretary of Health and Human Services or the Secretary of Education (other than services provided and funded solely under titles XVIII and XIX of the Social Security Act); or

(ii) administered by the Secretary of Agriculture in case of a clinic; or

(B) that are provided in indoor facilities that are constructed, operated, or maintained with such Federal funds, as determined by the appropriate Secretary in any enforcement action under this title, except that nothing in clause (ii) of subparagraph (A) is intended to include facilities (other than clinics) where coupons are redeemed under the Child Nutrition Act of 1966.

(3) PERSON. The term "person" means any State or local subdivision thereof, agency of such State or subdivision, corporation, or partnership that owns or operates or otherwise controls and provides children's services or any individual who owns or operates or otherwise controls and provides such services.

SEC. 1043. NONSMOKING POLICY FOR CHILDREN'S SERVICES.

(a) PROHIBITION. After the date of the enactment of this Act, no person shall permit smoking within any indoor facility owned or leased or contracted for and utilized by such person for provision of routine or regular kindergarten, elementary, or secondary education or library services to children.

(b) ADDITIONAL PROHIBITION. After the date of the enactment of this Act, no person shall permit smoking within any indoor facility (or portion thereof) owned or leased or contracted for and utilized by such person of regular or routine health care or day care or early childhood development (Head Start) services to children or for the use of the employees of such person who provides such services.

(c) FEDERAL AGENCIES.

(1) KINDERGARTEN, ELEMENTARY, OR SECONDARY EDUCATION OR LIBRARY SERVICES. After the date of the enactment of this Act, no Federal agency shall permit smoking within any indoor facility in the United States operated by such agency, directly or by contract, to provide routine or regular kindergarten, elementary, or secondary education or library services to children.

(e) SPECIAL WAIVER.

(1) IN GENERAL. On receipt of an application, the head of the Federal agency may grant a special waiver to a person described in subsection (a) who employs individuals who are members of a labor organization and provide children's services pursuant to a collective bargaining agreement that —

(A) took effect before the date of enactment of this Act; and

(B) includes provisions relating to smoking privileges that are in violation of the requirements of this section.

(2) TERMINATION OF WAIVER. A special waiver granted under this subsection shall terminate on the earlier of —

(A) the first expiration date (after the date of enactment of this Act) of the collective bargaining agreement containing the provisions relating to smoking privileges; or

(B) the date that is 1 year after the date of the enactment of this Act.

(f) CIVIL PENALTIES.

(1) IN GENERAL. Any failure to comply with a prohibition in this section shall be a violation of this section and any person subject to such prohibition who commits such violation, or may be subject to an administrative compliance order, or both, as determined by the Secretary. Each day a violation continues shall constitute a separate violation.

Radon

Background Information

The EPA and other major national and international scientific organizations have concluded that radon is a human carcinogen and a serious public health problem. An individual's risk of developing lung cancer from radon increases with the level of radon, the duration of exposure, and the individual's smoking habits. EPA estimates that 7,000 to 30,000 lung cancer deaths in the United States each year are attributed to radon. Because many people spend much of their time at home, the home is likely to be the most significant source of radon exposure. For most school children and staff, the second largest contributor to their radon exposure is likely to be their school. As a result, EPA recommends that school buildings as well as homes be tested for radon.

Results from a National Survey of Radon Levels in Schools

A nationwide survey of radon levels in schools estimates that 19.3% of U.S. schools, nearly one in five, have at least one frequently occupied ground-contact room with short-term radon levels at or above the action level of 4 pCi/L (picocuries per liter) — the level at which EPA recommends mitigation. Approximately 73% of these schools will have only five or less school rooms with radon levels above the action level. The other 27% will have six or more such schoolrooms. If your building has a radon problem, it is unlikely that every room in your school will have an elevated radon level. However, testing all frequently-occupied rooms that have contact with the ground is necessary to identify schoolrooms with elevated radon levels.

Guidance for Radon Testing

EPA's document, *Radon Measurement in Schools - Revised Edition* (EPA 402-R-92-014), provides guidance on planning, implementing, and evaluating a radon testing program for a school. To assist schools with testing, helpful aids such as a checklist of the testing procedure is included in the document. However, before initiating radon testing in your school, contact your State Radon Office (see *Resources*, **Appendix I**) for information on any State requirements concerning radon testing, or for a copy of the document. Check www.epa.gov/iaq/schools for radon in schools documents.

To reduce the health risk associated with radon, EPA recommends that officials test every school for elevated radon levels. Because the entry and movement of radon in buildings is difficult to predict, officials should test all frequently occupied schoolrooms that are in contact with the ground. If testing identifies schoolrooms with radon levels of 4 pCi/L or greater, officials should reduce the radon levels to below 4 pCi/L using an appropriate mitigation strategy.

Guidance for Radon Mitigation

If you identify a radon problem in your school, EPA has developed guidance on radon mitigation entitled *Reducing Radon in Schools — A Team Approach* (EPA 402-R-94-008) that describes the recommended approach to radon mitigation in schools and provides an overview of the mitigation process to the IAQ Coordinator.

For a free copy, please call 1-800-490-9198 or contact your State Radon Office (see **Appendix I**, *Resources*).

Guidance for Radon Prevention in Renovations and New Buildings

EPA's document entitled *Radon Prevention in Design and Construction of Schools and Other Large Buildings* (EPA 625R-92-016) provides guidance for incorporating radon resistant and/or easy-to-mitigate features into the design of a new school building including design recommendations for HVAC systems. This guidance is useful to school personnel (e.g., school business officials) or architects involved with the new building construction in a school district.

For a free copy, contact 1-800-490-9198.

Training for Testing and Mitigation

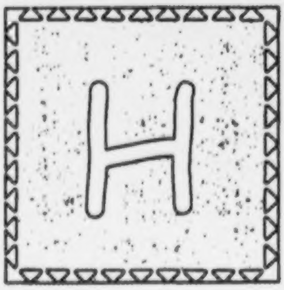
To develop public and private sector capabilities for radon testing and mitigation, EPA has formed four Regional Radon Training Centers (see *Resources*, **Appendix I**). These training centers offer courses on testing and mitigation in school buildings designed to simulate hands-on activities by having participants solve practical problems. Contact your State Radon Office (see *Resources*, **Appendix I**) for information on local training opportunities or on state training requirements.

Testing and Mitigation Costs

Cost for radon testing in a typical school building ranges from $500 to $1,500. The type of measurement device used, the size of the school, and whether testing is performed in-house using school personnel or a measurement contractor will influence testing costs.

If a radon problem is identified, the cost for radon mitigation typically ranges from $3,000 to $30,000 per school. The mitigation strategy, the school building design, the radon concentration in the school room(s), and the number of school rooms that need mitigation influence the cost of mitigating a school. The appropriate mitigation strategy will depend on the school building design and initial levels of radon. Mitigation costs at the high end of the cost range are often associated with a mitigation strategy involving the renovation of a school's heating, ventilation, and air-conditioning (HVAC) system. Although the cost is higher, this strategy has the added benefit of improving ventilation within a school building which contributes to the improvement of indoor air quality.

Mold and Mosture



Molds can be found almost anywhere; they can grow on virtually any substance, providing moisture is present. There are molds that can grow on and within wood, paper, carpet and foods. When excessive moisture accumulates in buildings or on building materials, mold growth will often occur, particularly if the moisture problem remains undiscovered or unaddressed. There is no practical way to eliminate all mold and mold spores in the indoor environment; the way to control indoor mold growth is to control moisture.

Molds produce tiny spores to reproduce. Mold spores waft through the indoor and outdoor air continually. When mold spores land on a damp spot indoors, they may begin growing and digesting whatever they are growing on in order to survive.

There are many different kinds of mold. Molds can produce allergens, toxins, and/or irritants. Molds can cause discoloration and odor problems, deteriorate building materials, and lead to health problems such as asthma episodes and allergic reactions in susceptible individuals.

The key to mold control is moisture control. If mold is a problem, clean up the mold and get rid of excess water or moisture. Maintaining the relative humidity between 30%-60% will help control mold.

Condensation, Relative Humidity, and Vapor Pressure

Mold growth does not require the presence of standing water, leaks, or floods; mold can grow when the relative humidity of the air is high. Mold can also grow in damp areas such as unvented bathrooms and kitchens, crawl spaces, utility tunnels, gym areas and locker rooms, wet foundations, leaky roof areas, and damp basements. Relative humidity and the factors that govern it are often misunderstood. This section discusses relative humidity and describes common moisture problems and their solutions.

Water enters buildings both as a liquid and as a gas (water vapor). Water is introduced intentionally at bathrooms, gym areas, kitchens, art and utility areas, and accidentally by way of leaks and spills. Some of the water evaporates and joins the water vapor that is exhaled by building occupants. Water vapor also moves into the building through the ventilation system, through openings in the building shell, or directly through building materials.

The ability of air to hold water vapor decreases as the air temperature falls. If a unit of air contains half of the water vapor it can hold, it is said to be at least 50% relative humidity (RH). The RH increases as the air cools and approaches saturation. When air contains all of the water vapor it can hold, it is at least 100% RH, and the water vapor condenses, changing from a gas to a liquid. The temperature at which condensation occurs is the "dew point."

It is possible to reach 100% RH without changing the air temperature, by increasing the amount of water vapor in the air (the "absolute humidity" or "vapor pressure"). It is also possible to reach 100% RH without changing the amount of water vapor in the air, by lowering the air temperature to the "dew point."

The highest RH in a room is always next to the coldest surface. This is

Molds gradually destroy the things they grow on. Prevent damage to building materials and furnishings and save money by eliminating mold growth.

referred to as the "first condensing surface," as it will be the location where condensation happens first, if the relative humidity of the air next to the surface reaches 100%. It is important to understand this when trying to understand why mold is growing on one patch of wall or only along the wall-ceiling joint. It is likely that the surface of the wall is cooler than the room air because there is a gap in the insulation or because the wind is blowing through cracks in the exterior of the building.

Taking Steps to Reduce Moisture and Mold

Moisture control is the key to mold control. Respond to water damage within 24-48 hours to prevent mold growth.

Mold growth can be reduced if relative humidities near surfaces can be maintained below the dew point. This can be done by: 1) reducing the moisture content (vapor pressure) of the air, 2) increasing air movement at the surface, or 3) increasing the air temperature (either the general space temperature or the temperature at building surfaces).

Either vapor pressure or surface temperature can be the dominant factor in a mold problem. A vapor pressure dominated mold problem may not respond well to increasing temperatures, whereas a surface temperature dominated mold problem may not respond very well to increasing ventilation. Understanding which factor dominates will help in selecting an effective control strategy.

If the relative humidity near the middle of a room is fairly high (e.g., 50% at 70°F), mold or mildew problems in the room are likely to be vapor pressure dominated. If the relative humidity near the middle of a room is fairly low (e.g. 30% at 70°F), mold or mildew problems in the room are likely to be surface temperature dominated.

Vapor Pressure Dominated Mold Growth

Vapor pressure dominated mold growth can be reduced by using one or more of the following strategies:

- use source control (e.g., direct venting of moisture-generating activities such as showers to the exterior)
- dilute moisture-laden indoor air with outdoor air at a lower absolute humidity
- dehumidify the indoor air

Note that dilution is only useful as a control strategy during heating periods, when cold outdoor air contains little total moisture. During cooling periods, outdoor air often contains as much moisture as indoor air.

Consider an old, leaky, poorly insulated school in Maine that has mold and mildew in the coldest corners of one classroom. The indoor relative humidity is low (30%). It is winter and cold air cannot hold much water vapor. Therefore, outdoor air entering through leaks in the building lowers the airborne moisture levels indoors. This is an example of a surface temperature dominated mold problem. In this building, increasing the outdoor air ventilation rate is probably not an effective way to control interior mold and mildew. A better strategy would be to increase surface temperatures by insulating the exterior walls, thereby reducing relative humidity in the corners.

Consider a school locker room that has mold on the ceiling. The locker room exhaust fan is broken, and the relative humidity in the room is 60% at 70°F. This is an example of a vapor pressure dominated mold problem. In this case, increasing the surface temperature is probably not an effective way to correct the mold problem. A better strategy is to repair or replace the exhaust fan.

Surface Temperature Dominated Mold Growth

Surface temperature dominated mold growth can be reduced by increasing the surface temperature using one or more of the following approaches:

- raise the temperature of the air near room surfaces
- raise the thermostat setting
- improve air circulation so that supply air is more effective at heating the room surfaces
- decrease the heat loss from room surfaces
- add insulation
- close cracks in the exterior wall to prevent "wind washing" (air that enters a wall at one exterior location and exits another exterior location without penetrating into the building)

Mold Clean Up

The key to mold control is moisture control. It is essential to clean up the mold and get rid of excess water or moisture. If the excess water or moisture problem is not fixed, mold will most probably grow again, even if the area was completely cleaned. Clean hard surfaces with water and detergent and dry quickly and completely. Absorbent materials such as ceiling tiles may have to be discarded.

Note that mold can cause health effects such as allergic reactions; remediators should avoid exposing themselves and others to mold.

Wear waterproof gloves during clean up; do not touch mold or moldy items with bare hands. Respiratory protection should be used in most remediation situations to prevent inhalation exposure to mold. Respiratory protection may not be necessary for small remediation jobs with little exposure potential. Refer to **Appendix I**, *Resources*, for sources of more information on mold remediation. When in doubt consult a professional, experienced remediator.

Identifying and Correcting Common Mold and Moisture Problems

Exterior Corners and Walls

The interior surfaces of exterior corners and behind furnishings such as chalk boards, file cabinets, and desks next to outside walls are common locations for mold growth in heating climates. They tend to be closer to the outdoor temperature than other parts of the building surface for one or more of the following reasons:

- poor indoor air circulation
- wind washing
- low insulation levels
- greater surface area of heat loss

Sometimes mold growth can be reduced by removing obstructions to airflow (e.g., rearranging furniture). Buildings with forced air heating systems and/or room ceiling fans tend to have fewer mold problems than buildings with less air movement.

Set-Back Thermostats

Set-back thermostats (programmable thermostats) are commonly used to reduce energy consumption during the heating season. Mold growth can occur when temperatures are lowered in buildings with high relative humidity. (Maintaining a room at too low a temperature can have the same effect as a set-back thermostat.) Mold can often be controlled in heating climates by increasing interior temperatures during heating periods. Unfortunately, this also increases energy consumption and reduces relative humidity in the breathing zone, which can create discomfort.

Air-Conditioned Spaces

Mold problems can be as extensive in cooling climates as in heating climates. The same principles apply: either surfaces are too cold, moisture levels are too high or both.

One common example of mold growth in cooling climates can be found in rooms where conditioned "cold" air blows against the interior surface of an exterior wall. This condition, which may be due to poor duct design, diffuser location, or diffuser performances, creates a cold spot at the interior finish surfaces, possibly allowing moisture to condense.

Possible solutions for this problem include:

- eliminate the cold spots (i.e., elevate the temperature of the surface) by adjusting the diffusers or deflecting the air away from the condensing surface
- increase the room temperature to avoid overcooling. NOTE: During the cooling season, increasing temperature decreases energy consumption, though it could cause comfort problems.

Mold problems can also occur within the wall cavity, when outdoor air comes in contact with the cavity side of the cooled interior surface. It is a particular problem in room decorated with low maintenance interior finishes (e.g., impermeable wall covering such as vinyl wallpaper) which can trap moisture between the interior finish and the gypsum board. Mold growth can be rampant when these interior finishes are coupled with cold spots and exterior moisture.

A possible solution for this problem is to ensure that vapor barriers, facing sealants, and insulation are properly specified, installed and maintained.

Thermal Bridges

Localized cooling of surfaces commonly occurs as a result of "thermal bridges," elements of the building structure that are highly conductive of heat (e.g., steel studs in exterior frame walls, uninsulated window lintels, and the edges of concrete floor slabs). Dust particles sometimes mark the locations of thermal bridges, because dust tends to adhere to cold spots.

The use of insulating sheathings significantly reduces the impact of thermal bridges in building envelopes.

Window

In winter, windows are typically the coldest surfaces in a room. The interior surface of a window is often the first condensing surface in a room.

Condensation on window surfaces has historically been controlled by using storm windows or "insulated glass" (e.g., double-glazed windows or selective surface gas-filled windows) to raise interior surface temperatures. In older building enclosures with less advanced glazing systems, visible condensation on the windows often alerted occupants to the need for ventilation to flush out interior moisture, so they knew to open the windows.

The advent of higher performance glazing systems has led to a greater number of moisture problems in heating climate building enclosures, because the buildings can now be operated at higher interior vapor pressures (moisture levels) without visible surface condensation on windows.

Concealed Condensation

The use of thermal insulation in wall cavities increases interior surface temperatures in heating climates, reducing the likelihood of interior surface mold and condensation. However, the use of thermal insulation without a properly installed air barrier may increase moisture condensation within the wall cavity.

The first condensing surface in a wall cavity in a heating climate is typically the inner surface of the exterior sheathing.

Concealed condensation can be controlled by either or both of the following strategies:

- reducing the entry of moisture into the wall cavities (e.g., by controlling entry and/or exit of moisture-laden air)
- raising the temperature of the first condensing surface
- in heating-climate locations: installing exterior insulation (assuming that no significant wind-washing is occurring)
- in cooling-climate locations: installing insulating sheathing to the interior of the wall framing and between the wall framing and the interior gypsum board

Mold and Health Effects

Molds are a major source of indoor allergens. Molds can also trigger asthma. Even when dead or unable to grow, mold can cause health effects such as allergic reactions. The types and severity of health effects associated with exposure to mold depend, in part, on the type of mold present, and the extent of the occupants' exposure and existing sensitivities or allergies. Prompt and effective remediation of moisture problems is essential to minimize potential mold exposures and their potential health effects.

Resources

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This Appendix lists organizations with information or services related to indoor air quality. In addition, the Appendix includes a section on indoor air quality related publications. Following is a listing of the subsections contained in this Appendix.

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Federal Agencies With Major Indoor Air Responsibilities For Public and Commercial Buildings

U.S. Environmental Protection Agency conducts a non-regulatory indoor air quality program that emphasizes research, information dissemination, technical guidance, and training. EPA issues regulations and carries out other activities that affect indoor air quality under the laws for pesticides, toxic substances, and drinking water.

Indoor Air Quality
Information Clearinghouse
P.O. Box 37133
Washington, DC 20013-7133
Toll Free: 1-800-438-4318
Local: 202-356-5346
Fax: 202-356-5386

Information specialists are on duty Monday - Friday 9:00 am to 5:00 pm eastern time. Provides indoor air quality information and publications.

Occupational Safety and Health Administration promulgates safety and health standards, facilitates training and consultation, and enforces regulations to ensure that workers are provided with safe and healthful working conditions. (For further information contact OSHA Regional Offices.)

National Institute for Occupational Safety and Health conducts research, recommends standards to the U.S. Department of Labor, and conducts training on various issues including indoor air quality to promote safe and healthful workplaces. Undertakes investigations at request of employees, employers, other federal agencies, and state and local agencies to identify and mitigate workplace problems.

Requests for Field Investigations:

NIOSH
Hazard Evaluations and Technical
Assistance Branch (R-9)
4676 Columbia Parkway
Cincinnati, OH 45226
513-841-4382

Requests for Information:

1-800-35-NIOSH
www.cdc.gov/niosh

EPA Regional Offices

Address inquiries to IAQ staff in the EPA Regional Offices at the following addresses:

(CT,ME,MA,NH,RI,VT)
EPA Region 1
1 Congress Street, Ste. 1100 (CPT)
Boston, MA 02114-2023
617-918-1639 (indoor air)
617-918-1534 (radon)
617-918-1524 (asbestos)

(NJ,NY,PR,VI)
EPA Region 2
290 Broadway (MC R2DEPDIV)
28th Floor
New York, NY 10007-1866
212-637-4013 (indoor air)
212-637-4013 (radon)
212-637-4081 (asbestos)

(DC,DE,MD,PA,VA,WV)
EPA Region 3
1650 Arch Street, (3AP23)
Philadelphia, PA 19103-2029
215-814-2083 (indoor air)
215-814-2086 (radon)
215-814-2103 (asbestos)

(AL,FL,GA,KY,MS,NC,SC,TN)
EPA Region 4
61 Forsyth Street, SW
Atlanta, GA 30303-3104
404-562-9136 (indoor air)
404-564-9145 (radon)
404-562-8978 (asbestos)

(IL,IN,MI,MN,OH,WI)
EPA Region 5
77 W. Jackson Boulevard
(MC AE-17J)
Chicago, IL 60604-3590
Region 5 Environmental Hotline:
1-800-621-8431
312-353-2000 (outside Region 5)
312-353-6686 (indoor air, radon)
312-353-4370 (asbestos)

(AR,LA,NM,OK,TX)
EPA Region 6
1445 Ross Avenue (6 PD-T)
Dallas, TX 75202-2733
1-800-887-6063 (indoor air)
1-800-887-6063 (radon)
1-800-887-6063 (asbestos)

(IA,KS,MO,NE)
EPA Region 7
901 N. 5th Street (MC ARTD/RALI)
Kansas City, KS 66101
913-551-7260 (indoor air)
913-551-7260 (radon)
913-551-7260 (asbestos)

(CO,MT,ND,SD,UT,WY)
EPA Region 8
999 18th Street, Suite 500
(MC 8P-AR)
Denver, CO 80202-2466
303-312-6031 (indoor air, radon)
303-312-6204 (asbestos)

(AZ,CA,HI,NV,AS,GU)
EPA Region 9
75 Hawthorne Street (MC AIR-6)
San Francisco, CA 94105
415-744-1047 (indoor air)
415-744-1046 (radon)
415-744-1145 (asbestos)

(AK,ID,OR,WA)
EPA Region 10 (MC OAQ-107)
1200 Sixth Avenue
Seattle, WA 98101-9797
206-553-2589 (indoor air)
206-553-7660 (radon)
206-553-4762 (asbestos)

OSHA Regional Offices

(CT,ME,MA,NH,RI,VT)
OSHA Region 1
133 Portland Street, 1st Floor
Boston, MA 02114

(NJ,NY,PR,VI)
OSHA Region 2
201 Varick Street, Room 670
New York, NY 10014

(DC,DE,MD,PA,VA,WV)
OSHA Region 3
Gateway Building, Suite 2100
3535 Market Street
Philadelphia, PA 19104
215-596-1201

(AL,FL,GA,KY,MS,NC,SC,TN)
OSHA Region 4
1375 Peachtree Street, NE
Suite 587
Atlanta, GA 30367

(IL,IN,MI,MN,OH,WI)
OSHA Region 5
230 South Dearborn Street
Suite 3244
Chicago, IL 60604
312-353-2220

(AR,LA,NM,OK,TX)
OSHA Region 6
525 Griffin Street, Room 602
Dallas, TX 75202
214-767-4731

(IA,KS,MO,NE)
OSHA Region 7
911 Walnut Street, Room 406
Kansas City, MO 64106
816-426-5861

(CO,MT,ND,SD,UT,WY)
OSHA Region 8
Federal Building, Room 1576
1961 Stout Street
Denver, CO 80294

(AZ,CA,HI,NV,AS,GU)
OSHA Region 9
71 Stevenson Street, Suite 420
San Francisco, CA 94105

(AK,ID,OR,WA)
OSHA Region 10
1111 Third Avenue, Suite 715
Seattle, WA 98101-3212
206-553-5930

Other Federal Agencies with Indoor Air Responsibilities

Bonneville Power Administration
P.O. Box 3621-RMRD
Portland, OR 97208
503-230-5475
www.bpa.gov
Provides radon-resistant construction techniques, source control, and removal technology for indoor air pollutants.

Consumer Product Safety Commission
4330 East-West Hwy., Room 502
Bethesda, MD 20814
1-800-638-CPSC
www.cpsc.gov
Reviews complaints regarding the safety of consumer products and takes action to ensure product safety.

General Services Administration
18th and F Streets, NW
Washington, DC 20405
Writes indoor air quality policy for Federal buildings. Provides proactive indoor air quality building assessments. Assesses complaints and provides remedial action.

National Heart, Lung, & Blood Institute Information Center
P.O. Box 30105
Bethesda, MD 20824-0150
301-592-8573
www.nhlbi.nih.gov
Provides information and materials regarding asthma education and prevention

U.S. Department of Energy
Energy Efficiency and Renewable Energy
1000 Independence Avenue, SW
Washington, DC 20585
202-586-9220
www.doe.gov
Quantifies the relationship among infiltration, ventilation, and acceptable indoor air quality.

Centers for Disease Control & Prevention
Office on Smoking and Health
4770 Buford Highway, NE
Mail Stop K50
Atlanta, GA 30341
770-488-5705
www.cdc.gov
Disseminates information about the health effects of passive smoke and strategies for reducing exposure to secondhand smoke.

Tennessee Valley Authority
Occupational Hygiene Dept.
328 Multipurpose Building
Muscle Shoals, AL 35660-1010
205-386-2314
Provides building surveys and assessments associated with employee indoor air quality complaints.

State and Local Agencies

Your questions and concerns about indoor air problems can frequently be answered most readily by the government agencies in your State or locality. Responsibilities for indoor air quality issues are usually divided among many different agencies. You will often find that calling or writing the agencies responsible for health or air quality control is the best way to start getting information from your State or local government. Check the EPA web site for State agency contacts (www.epa.gov/iaq/contacts.html).

Building Management Associations

Association of Higher Education Facilities Offices (APPA)
1643 Front Street
Alexandria, VA 22314
703-684-1446
www.appa.org

Professional and Standards Setting Organizations

American Academy of Allergy and Immunology
611 East Wells Street
Milwaukee, WI 53202
414-272-6071
www.aaaai.org

Air and Waste Management Association
1 Gateway Center, 3rd Floor
Pittsburgh, PA 15222
412-232-3444
www.awma.org

Air-Conditioning and Refrigeration Institute
4301 N. Fairfax Dr., Suite 425
Arlington, VA 22203
703-524-8800
www.ari.org

American Conference of Governmental Industrial Hygienists
1330 Kemper Meadow Drive
Cincinnati, OH 45240
513-742-2020
www.acgih.org

American Industrial Hygiene Association
2700 Prosperity Avenue
Suite 250
Fairfax, VA 22031
703-849-8888
www.aiaj.org

American Society for Testing and Materials
100 Bar Harbor Drive
West Conshohocken, PA 19428-2959
610-832-9710
www.astm.org

American Society of Heating, Refrigerating, and Air-Conditioning Engineers
1791 Tullie Circle, NE
Atlanta, GA 30329
404-636-8400
www.ashrae.org

Center for Safety in the Arts
Web site only:
http://artswire.org:70/csa
The Center has a list of products that are safe for children from grades K-6. The list is provided for a nominal charge.

Art and Craft Materials Institute
P.O. Box 479
Hanson, MA 02341
781-293-4100
www.acminet.org
Conducts a certification program to ensure nontoxicity (or proper labelling) and quality of products. Works to develop and maintain chronic hazard labelling standard for art and craft materials.

The American Institute of Architects
1735 New York Avenue, NW
Washington, DC 20006
202-626-7300
www.aiaonline.com

National Conference of States on Building Codes and Standards, Inc.
505 Huntmar Park Drive
Suite 210
Herndon, VA 20170
703-437-0100
www.ncsbcs.org

Product Manufacturer Associations

Adhesive and Sealant Council
7979 Old Georgetown Road
Bethesda, MD 20814
301-986-9700
www.ascouncil .org

Abestos Institute
1002 Sherbrooke St., West
Suite 1750
Montreal, Quebec
Canada H3A3L6
514-844-3956
www.asbestos-institute.ca:80/

Business Council on Indoor Air
2000 L Street, NW
Washington, DC 20036

Carpet and Rug Institute
310 Holiday Avenue
Dalton, GA 30720
706-278-3176
www.carpet-rug.com

Chemical Specialties Manufacturers' Association
1913 I Street, NW
Washington, DC 20006
202-872-8110
www.csma.org

Electric Power Research Institute
P.O. Box 10412
Palo Alto, CA 94303
650-855-2902
www.epri.com

Association of Wall and Ceiling Industries, International
803 West Broad Street
Suite 600
Falls Church, VA 22046
703-534-8300
http://www.awci.org/
email:jones@awci.org

Gas Research Institute
8600 West Bryn Mawr Avenue
Chicago, IL 60631
773-399-8100
www.gri.org

National Paint and Coatings Association
1500 Rhode Island Avenue, NW
Washington, DC 20005
202-462-6272
www.paint.org

North American Insulation Manufacturers' Association
44 Canal Center Plaza, Suite 310
Alexandria, VA 22314
703-684-0084
www.naima.org

Building Service Associations

Air-Conditioning and Refrigeration Institute
4301 North Fairfax Drive
Suite 425
Arlington, VA 22203
703-524-8800
www.ari.org

Air-Conditioning Contractors of America
1712 New Hampshire Ave., NW
Washington DC 20009
202-483-9370
www.acca.org

American Consulting Engineers Council
1015 15th Street, NW, Suite 802
Washington, DC 20005
202-347-7474
www.acec.org

Associated Air Balance Council
1518 K Street, NW, Suite 503
Washington, DC 20005
202-737-0202
www.aabchg.com

Association of Energy Engineers
4025 Pleasantdale Rd., Suite 420
Atlanta, GA 30340
404-447-5083
www.aeecenter.org

Association of Specialists in Cleaning and Restoration Intl.
8229 Clover Leaf Drive, Suite 460
Millersville, MD 21108
410-729-9900
www.ascr.org

National Air Duct Cleaners Association
1518 K Street, NW, Suite 503
Washington, DC 20005
202-737-2926
www.nadca.com

National Association of Power Engineers
5707 Seminary Rd, Suite 200
Falls Church, VA 22041
703-845-7055

National Energy Management Institute
601 North Fairfax St., Suite 120
Alexandria, VA 22314
703-739-7100

National Environmental Balancing Bureau
8575 Grovemont Circle
Gaithersburg, MD 20877-4121
301-977-3698
www.nebb.org

National Pest Control Association
8100 Oak Street
Dunn Loring, VA 22027
703-573-8330
www.pestworld.org

Sheet Metal and Air Conditioning Contractors National Association
P.O. Box 221230
Chantilly, VA 20153
703-803-2980
www.smacna.org

Unions

American Federation of Teachers
555 New Jersey Avenue, NW
Washington, DC 20001
202-879-4400
www.aft.org

American Association of Classified School Employees
PO Box 640
San Jose, CA 95106

National Education Association
1201 16th Street, NW
Washington, DC 20036
202-833-4000
www.nea.org

National Association of School Nurses
PO Box 1300
Scarborough, ME 04070-1300
207-883-2117
www.nasn.org

Environmental/Health/ Consumer Organizations

American Lung Association
or your local lung association
1740 Broadway
New York, NY 10019
212-315-8700
www.lungusa.org

Consumer Federation of America
1424 16th Street, NW, Suite 604
Washington, DC 20036
202-387-6121
www.consumerfed.org

National Environmental Health Association
720 South Colorado Blvd.
South Tower, Suite 970
Denver, CO 80222
303-756-9090
www.neha.org

Occupational Health Foundation
815 16th Street, NW, Room 312
Washington, DC 20006

MCS-Related Organizations

Human Ecology Action League (HEAL)
P.O. Box 29629
Atlanta, GA 30359
404-248-1898

National Center for Environmental Health Strategies
1100 Rural Avenue
Voorhees, NJ 08043
856-429-5358

National Foundation for the Chemically Hypersensitive
4407 Swinson Road
Rhodes, MI 48652
517-689-6369
www.mcsrelief.com

Organizations Offering Training on Indoor Air Quality

Also, note Regional Radon Training Centers on page 70.

American Industrial Hygiene Association
2700 Prosperity Avenue, Suite 250
Fairfax, VA 22031
703-849-8888
www.aiha.org
Sponsors indoor air quality courses in conjunction with meetings for AIHA members only.

American Society of Heating, Refrigerating, and Air-Conditioning Engineers
1791 Tullie Circle NE
Atlanta, GA 30329.
404-636-8400
www.ashrae.org
Sponsors professional development seminars on indoor air quality.

Mid-Atlantic Environmental Hygiene Resource Center
University City Science Center
3624 Market Street, 1st Floor East
Philadelphia, PA 19104
215-387-2255
Provide training to occupational safety and health professionals and paraprofessionals.

OSHA Training Institute
155 Times Drive
Des Plaines, IL 60018
Provides courses to assist health and safety professionals in evaluating indoor air quality.

Radon

State Radon Offices

For information, call the radon contact in the EPA Regional Office for your state, or visit www.epa.gov/iaq/contacts/index.html

Regional Radon Training Centers

EPA has coordinated the formation of four Regional Radon Training Centers (RRTCs). The RRTCs provide a range of radon training and proficiency examination courses to the public for a fee.

(ERRTC) Rutgers, The University of New Jersey
21 Road One, Building 4087
Piscataway, NJ 08854-8031
732-445-2582
www.envsci.rutgers.edu/~errtc/
see also: www.ifas.ufl.edu/schoolipm

Consortium (MURC)
University of Minnesota
1985 Buford Avenue (240)
St. Paul, MN 55108-6134
612-624-8747
www.dha.che.umn.edu/murc
www.dehs.umn.edu/draft/schooliaq.html

Western Regional Radon Training Center (WRRTC)
525 E. Fountain Blvd.
Colorado Springs, CO 80903
1-800-513-8332 or
719-636-2482

Southern Regional Radon Training Center (SRRTC)
Auburn University
217 Ramsey Hall
Auburn University, AL 36849-5331
334-844-5718 or 800-626-2703

EPA Regional Offices

If you need additional information in radon, contact the EPA Regional Offices listed on pages 66.

Other EPA Contacts and Programs of Interest

Asbestos and Small Business Ombudsman
1-800-368-5888
Provides information on asbestos.

National Lead Information Center
1-800-424-5323
Provides information on lead, lead contamination, and lead hazards.

National Pesticides Telecommunications Network
1-800-858-7378
In Texas: 806-743-3091
Provides information on pesticides, hazards and risks.

RCRA/Superfund/EPCRA Hotline
1-800-424-9346

Safe Drinking Water Hotline
1-800-426-4791
Provides information on lead in drinking water.

Stratospheric Ozone Information Hotline 1-800-296-1996

Provides information on chlorofluorocarbons (CFCs).

TSCA Hotline Service
202-554-1404
Provides information on asbestos and other toxic substances.

EPA Energy Star Programs
1200 Pennsylvania Avenue, NW.
#6202J
Washington, DC 20460
1-888-STAR-YES
www.epa.gov/energystar

Publications

Items marked * are available from the **National Service Center for Environmental Publications** (NSCEP) Fax: 513-489-8695
1-800-490-9198
www.epa.gov/ncepihom/

Items marked ** are available from **TSCA Assistance Hotline (TS-799)**, 401 M Street, SW, Washington, DC 20460.
202-554-1404.

Items marked *** are available from **NIOSH Publications Dissemination**, 4676 Columbia Parkway, Cincinnati, OH 45202.
513-533-8287.

General Information

******Building Air Quality: A Guide for Building Owners and Facility Managers*. U.S. Environmental Protection Agency and the U.S. Department of Health and Human Services December 1991. Available from Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954
EPA-400-191-033

Indoor Air Pollution Control. Thad Godish. 1989. Lewis Publishers, 121 South Main Street, Chelsea, MI 48118.

Problem Buildings: Building-Associated Illness and the Sick Building Syndrome. James E. Cone and Michael J. Hodgson, MD, MPH. 1989. From the series "Occupational Medicine: State of the Art Reviews." Hanley & Belfus, Inc., 210 South 13th Street, Philadelphia, PA 19107.

Report of the Inter-ministerial Committee on Indoor Air Quality, 1988. G. Rajhans. Contact: G. Rajhans, Health and Safety Support Services Branch, Ministry of Labour, 400 University Avenue, 7th Floor, Toronto, Ontario, Canada M7A 1T7.

Indoor Air Quality

**Introduction to Indoor Air Quality: A Self-Paced Learning Module.* National Environmental Health Association and U.S. Environmental Protection Agency. June 1991. Introduces environmental health professionals to the information needed to recognize, evaluate, and control indoor air quality problems. EPA400-39-1002

**Introduction to Indoor Air Quality: A Reference Manual.* National Environmental Health Association, U.S. Public Health Service and U.S. Environmental Protection Agency. June 1991. Companion document to the Learning Module. Provides reference material on selected indoor air quality topics. EPA400-39-1003

**Indoor Air Pollution: An Introduction for Health Professionals.* The American Lung Association, American Medical Association, U.S. Consumer Product Safety Commission and U.S. Environmental Protection Agency. Manual assists health professionals in diagnosing symptoms that may be related to an indoor air pollution problem. EPA402R-94-007

Managing Asthma: A Guide for Schools. Available from NHLBI, P.O. Box 30105, Bethesda, MD 20824. Pub. 91-2650. Other asthma-related materials also available.

**The Inside Story: A Guide to Indoor Air Quality.* U.S. Environmental Protection Agency and the U.S. Consumer Product Safety Commission. 1988. Addresses residential indoor air quality primarily, but contains a section on offices.
EPA 402K-95-001

**Sick Building Syndrome. Indoor Air Quality Fact Sheet #4.* U.S. Environmental Protection Agency. Revised, 1991. EPA 402F-94-004

**Ventilation and Air Quality in Offices. Indoor Air Quality Fact Sheet #3.* U.S. Environmental Protection Agency. Revised, 1990. EPA 402 F-94-003

Air Quality Guidelines for Europe. World Health Organization. 1987. WHO Regional Publications, European Series No. 23. Available from WHO Publications Center USA, 49 Sheridan Avenue, Albany, NY 12210.

Radon

**Radon Measurements in Schools - Revised edition.* U.S. Environmental Protection Agency. 1993.
EPA 402 R-92-014.

Radon Measurement in Schools: Self-Paced Training Workbook. U.S. Environmental Protection Agency. 1994. EPA 402/B-94-001.

**Reducing Radon in Schools: A Team Approach.* U.S. Environmental Protection Agency. 1994.
EPA 402 R-94-008.

**Radon Prevention in the Design and Construction of Schools and Other Large Buildings, with Addendum.* U.S. Environmental Protection Agency. June 1994. EPA 625 R-92-016.

Secondhand Smoke

**Secondhand Smoke: What You Can Do About Secondhand Smoke as Parents, Decisionmakers, and Building Occupants.* U.S. Environmental Protection Agency. July 1993. A useful brochure describing the health implications of secondhand smoke and ways to avoid its risks. EPA 402 F-93-004 (Available in English, Spanish, Chinese)

**Respiratory Health Effects of Passive Smoking* fact sheet. U.S. Environmental Protection Agency. January 1993. 430-F-93-004

**Setting the Record Straight: Secondhand Smoke is a Preventable Health Risk: fact sheet.* U.S. Environmental Protection Agency. June 1994.
EPA 402 F-94-005.

Guidelines for Controlling Environmental Tobacco Smoke In Schools — Technical Bulletin. Ronald Turner, Bruce Lippy, Arthur Wheeler. Februrary 1991. Maryland State Department of Education, Office of Administration and Finance, Office of School Facilities, 200 West Baltimore Street, Baltimore, MD 21201.

Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders. U.S. Environmental Protection Agency. 1990. EPA/600/6090/006F. EPA's major risk assessment of the health effects of passive smoking (ETS).

The Health Consequences of Involuntary Smoking: A Report of the Surgeon General. U.S. Department of Health and Human Services. Public Health Service. Office on Smoking and Health. 1986. 1600 Clifton Road, NE (Mail Stop K50) Atlanta, GA 30333.

Current Intelligence Bulletin 54: Environmental Tobacco Smoke in the Workplace — Lung Cancer and Other Health Effects. *** U.S. Department of Health and Human Services, Public Health Service. Centers for Disease Control, National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 91-108. 1991.

A series of one-page information sheets on all aspects of smoking in the workplace. U.S. Department of Health and Human Services, National Cancer Institute. Office of Cancer Communications. For copies, call 1-800-4-CANCER.

Asbestos

A Guide to Monitoring Airborne Asbestos in Buildings. Dale L. Keyes and Jean Chesson. 1989. Environmental Sciences, Inc., 105 E. Speedway Blvd., Tucson, Arizona 85705.

Testimony of NIOSH on the Occupational Safety and Health Administration's Proposed Rule on Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite. U.S. Department of Health and Human Services, Public Health Service, U.S. Centers for Disease Control, National Institute of Occupational Safety and Health. June 1984, May 1990, and January 1991. NIOSH Docket Office, C-34, 4676 Columbia Parkway, Cincinnati, OH 45226.

A Guide to Respiratory Protection for the Asbestos Abatement Industry. ** U.S. Environmental Protection Agency. 1986. EPA 560/OTS 86-001.

Abatement of Asbestos-Containing Pipe Insulation. ** U.S. Environmental Protection Agency. 1986. Technical Bulletin No. 1986-2.

Asbestos Abatement Projects: Worker Protection. 40 CFR Part 763. ** U.S. Environmental Protection Agency. February 1987.

Asbestos Ban and Phaseout Rule. 40 CFR Parts 763.160 to 763.179.** U.S. Environmental Protection Agency. Federal Register, July 12, 1989.

Asbestos in Buildings: Guidance for Service and Maintenance Personnel (English/Spanish). ** U.S. Environmental Protection Agency. 1985. EPA 560/5-85-018. ("Custodial Pamphlet").

Asbestos in Buildings: Simplified Sampling Scheme for Surfacing Materials. ** U.S. Environmental Protection Agency. 1985. 560/5-85-030A. ("Pink Book").

Construction Industry Asbestos Standard. 29 CFR Part 1926.58.

General Industry Asbestos Standard. 29 CFR Part 1910.1001.

Guidance for Controlling Asbestos-Containing Materials in Buildings. ** U.S. Environmental Protection Agency. 1985. EPA 560/5-85-024. ("Purple Book").

Guidelines for Conducting the AHERA TEM Clearance Test to Determine Completion of an Asbestos Abatement Project. ** U.S. Environmental Protection Agency. EPA 560/5-89-001.

Managing Asbestos In Place: A Building Owner's Guide to Operations and Maintenance Programs for Asbestos-Containing Materials. ** U.S. Environmental Protection Agency. 1990. ("Green Book").

Measuring Airborne Asbestos Following An Abatement Action. ** U.S. Environmental Protection Agency. 1985. EPA 600/4-85-049. ("Silver Book").

National Emission Standards for Hazardous Air Pollutants. 40 CFR Part 61. ** U.S. Environmental Protection Agency. April 1984.

Transmission Electron Microscopy Asbestos Laboratories: Quality Assurance Guidelines. ** U.S. Environmental Protection Agency. 1989. EPA 560/5-90-002. Respiratory Protection Standard. 29 CFR Part 1910.134.

Biological Contaminants

Mold Remediation in Schools and Large Buildings. * (scheduled to be available 12/00) U.S. Environmental Protection Agency.

Biological Pollutants in Your Home. * webpage: http://www.epa.gov/iaq/pubs/bio_1.html Prepared by: The Consumer Product Safety Commission (CPSC), and the American Lung Association.

Bioaerosols, Assessment and Control. American Conference of Governmental Industrial Hygienists, Inc. 1999. Cincinnati, Ohio. ISBN 1-882417-29-1 phone 513-742-2020 http://www.acgih.org

Guidelines for the Assessment of Bioaerosols in the Indoor Environment. American Council of Governmental Industrial Hygienists. 1989. 6500 Glenway Avenue, Building D-7, Cincinnati, OH 45211.

PCBs

A Recommended Standard for Occupational Exposure to Polychlorinated Biphenyls. U.S. Department of Health and Human Services. Public Health Service. Centers for Disease Control. National Institute for Occupational Safety and Health. DHHS (NIOSH) Publication No. 77-225. 1977. Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

Current Intelligence Bulletin 45: Polychlorinated Biphenyls—Potential Health Hazards from Electrical Equipment Fires or Failures. U.S. Department of Health And Human Services. Public Health Service. Centers for Disease Control. National Institute of Occupational Safety and Health. DHHS (NIOSH) Publication No. 86-111. 1977. Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

Transformers and the Risk of Fire: A Guide for Building Owners. ** U.S. Environmental Protection Agency. 1986. OPA/86-001.

Building Management, Investigation, and Remediation

**Building Air Quality: A Guide for Building Owners and Facility Managers.* U.S. Environmental Protection Agency and the U.S. Department of Health and Human Services December 1991. EPA 402F-91-102.

Carpet and Indoor Air Quality in Schools. Maryland Department of Education. October 1993. Maryland State Department of Education, Division of Business Services, School Facilities Branch, 200 West Baltimore Street, Baltimore, MD 21201. 410-333-2508.

Guidance for Indoor Air Quality Investigations. *** U.S. Department of Health and Human Services. Public Health Service. Centers for Disease Control. National Institute for Occupational Safety and Health. 1987.

Indoor Air Quality: Selected References. *** U.S. Department of Health and Human Services. Public Health Service. Centers for Disease Control. National Institute for Occupational Safety and Health. 1989.

Interior Painting and Indoor Air Quality in Schools. Bruce Jacobs, March 1994. Maryland State Department of Education, Division of Business Services, School Facilities Branch, 200 West Baltimore Street, Baltimore, MD 21201. 410-333-2508.

Managing Indoor Air Quality. Shirley J. Hansen. 1991. Fairmont Press, 700 Indian Trail, Lilburn, GA 30247.

Practical Manual for Good Indoor Air Quality. Hani Bazerghi and Catherine Arnoult. 1989. Quebec Association for Energy Management. 1259 Berri Street, Suite 510, Montreal, Quebec, Canada, H2L 4C7.

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404-636-8400.

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Glossary and Acronyms

AHERA. Asbestos Hazard Emergency Response Act

AHU. See "Air Handling Unit."

ASHRAE. American Society of Heating, Refrigerating, and Air-Conditioning Engineers. See **Appendix I:** *Resources* for more information.

ASTM. Consensus standard-setting organization. See **Appendix I:** *Resources* for more information.

Action Packet. Contains three components - an introductory memo, *IAQ Backgrounder*, and IAQ Checklist - to assist school personnel to implement an effective yet simple IAQ program in their school.

Air Cleaning. An IAQ control strategy to remove various airborne particulates and/or gases from the air. The three types of air cleaning most commonly used are particulate filtration, electrostatic precipitation, and gas sorption.

Air Exchange Rate. The rate at which outside air replaces indoor air in a space. Expressed in one of two ways: the number of changes of outside air per unit of time - air changes per hour (ACH); or the rate at which a volume of outside air enters per unit of time - cubic feet per minute (cfm).

Air Handling Unit (AHU). For purposes of this document refers to equipment that includes a blower or fan, heating and/or cooling coils, and related equipment such as controls, condensate drain pans, and air filters. Does not include ductwork, registers or grilles, or boilers and chillers.

Antimicrobial. Agent that kills microbial growth. See "disinfectant," "sanitizer," and "sterilizer."

BRI. See "Building-Related Illness."

Biological Contaminants. Biological contaminants are produced by living things. Common biological contaminates include mold, dust mites, pet dander (skin flakes), droppings and body parts from cockroaches, rodents and other pests or insects, viruses, and bacteria. Biological contaminants can be inhaled and can cause many types of health effects including allergic reactions, respiratory disorders, hypersensitivity diseases, and infectious diseases. Also referred to as "microbiologicals" or "microbials." See **Appendix E:** *Typical Indoor Air Pollutants* for more information.

Building-Related Illness. Diagnosable illness whose symptoms can be identified and whose cause can be directly attributed to airborne building pollutants (e.g., Legionnaire's disease, hypersensitivity pneumonitis).

Central AHU. See "Central Air Handling Unit."

Central Air Handling Unit. For purposes of this document, this is the same as an Air Handling Unit, but serves more than one area.

CFM. Cubic feet per minute. The amount of air, in cubic feet, that flows through a given space in one minute. 1 CFM equals approximately 2 liters per second (l/s).

CO. Carbon monoxide. See **Appendix E:** *Typical Indoor Air Pollutants* for more information.

CO_2. Carbon dioxide. See **Appendix C:** *IAQ Measuring Equipment*, and **Appendix E:** *Typical Indoor Air Pollutants* for more information.

Conditioned Air. Air that has been heated, cooled, humidified, or dehumidified to maintain an interior space within the "comfort zone." (Sometimes referred to as "tempered" air.)

Dampers. Controls that vary airflow through an air outlet, inlet, or duct. A damper position may be immovable, manually adjustable, or part of an automated control system.

Diffusers and Grilles. Components of the ventilation system that distribute and return air to promote air circulation in the occupied space. As used in this document, supply air enters a space through a diffuser or vent and return air leaves a space through a grille.

Disinfectants. One of three groups of antimicrobials registered by EPA for public health uses. EPA considers an antimicrobial to be a disinfectant when it destroys or irreversibly inactivates infectious or other undesirable organisms, but not necessarily their spores. EPA registers three types of disinfectant products based upon submitted efficacy data: limited, general or broad spectrum, and hospital disinfectant.

Drain Trap. A dip in the drain pipe of sinks, toilets, floor drains, etc., which is designed to stay filled with water, thereby preventing sewer gases from escaping into the room.

EPA. United States Environmental Protection Agency. See **Appendix I:** *Resources* for more information.

ETS. Environmental tobacco smoke. See **Appendix E:** *Typical Indoor Air Pollutants*, **Appendix F:** *Secondhand Smoke*, and **Appendix I:** *Resources* for more information.

Exhaust Ventilation. Mechanical removal of air from a building.

Flow Hood. Device that easily measures airflow quantity, typically up to 2,500 cfm.

HVAC. Heating, ventilation, and air-conditioning system.

Hypersensitivity Diseases. Diseases characterized by allergic responses to pollutants. The hypersensitivity diseases most clearly associated with indoor air quality are asthma, rhinitis, and hypersensitivity pneumonitis. Hypersensitivity pneumonitis is a rare but serious disease that involves progressive lung damage as long as there is exposure to the causative agent.

IAQ. Indoor air quality.

IAQ Backgrounder. A component of the Action Packet that provides a general introduction to IAQ issues, as well as IAQ program implementation information.

IAQ Checklist. A component of the Action Packet containing information and suggested easy-to-do activities for school staff to improve or maintain good indoor air quality. Each focuses on topic areas and actions that are targeted to particular school staff (e.g., teachers, administrators, kitchen staff, maintenance staff, etc.) or specific building functions (e.g., HVAC system, roofing, renovation, etc.). The Checklists are to be completed by the staff and returned to the IAQ Coordinator as a record of activities completed and assistance as requested.

IAQ Coordinator. An individual at the school and/or school district level who provides leadership and coordination of IAQ activities. See **Section 3** for more information.

IAQ Management Plan. A set of flexible and specific steps for preventing and resolving IAQ problems. See **Section 6** for more information.

IAQ Team. People who have a direct impact on IAQ in the schools (school staff, administrators, school board members, students and parents) and who implement the IAQ Action Packets. See **Section 3** for more information.

IPM. Integrated pest management. See **Appendix D:** *Developing Indoor Air Policies* for more information.

Indoor Air Pollutant. Particles and dust, fibers, mists, bioaerosols, and gases or vapors. See **Section 4** and **Appendix E:** *Typical Indoor Air Pollutants* for more information.

MCS. See "Multiple Chemical Sensitivity."

Make-up Air. See "Outdoor Air Supply."

Microbiologicals. See "Biological Contaminants."

Multiple Chemical Sensitivity. A condition in which a person reports sensitivity or intolerance (as distinct from "allergic") to a number of chemicals and other irritants at very low concentrations. There are different views among medical professionals about the existence, causes, diagnosis, and treatment of this condition.

NIOSH. National Institute for Occupational Safety and Health. See **Appendix I:** *Resources* for more information.

Negative Pressure. Condition that exists when less air is supplied to a space than is exhausted from the space, so the air pressure within that space is less than that in surrounding areas. Under this condition, if an opening exists, air will flow from surrounding areas into the negatively pressurized space.

OSHA. Occupational Safety and Health Administration. See **Appendix I:** *Resources* for more information.

Outdoor Air Supply. Air brought into a building from the outdoors (often through the ventilation system) that has not been previously circulated through the system.

PPM. Parts per million.

Plenum. Unducted air compartment used to return air to central air handling unit.

Pollutant Pathways. Avenues for distribution of pollutants in a building. HVAC systems are the primary pathways in most buildings; however all building components and occupants interact to affect how pollutants are distributed. See **Section 5** for more information.

Positive Pressure. Condition that exists when more air is supplied to a space than is exhausted, so the air pressure within that space is greater than that in surrounding areas. Under this condition, if an opening exists, air will flow from the positively pressurized space into surrounding areas.

Pressure, Static. In flowing air, the total pressure minus velocity pressure. The portion of the pressure that pushes equally in all directions.

Pressure, Total. In flowing air, the sum of the static pressure and the velocity pressure.

Pressure, Velocity. The pressure due to the air flow rate and density of the air.

Preventive Maintenance. Regular and systematic inspection, cleaning, and replacement of worn parts, materials, and systems. Preventive maintenance helps to prevent parts, material, and systems failure by ensuring that parts, materials and systems are in good working order.

Psychogenic Illness. This syndrome has been defined as a group of symptoms that develop in an individual (or a group of individuals in the same indoor environment) who are under some type of physical or emotional stress. This does not mean that individuals have a psychiatric disorder or that they are imagining symptoms.

Psychosocial Factors. Psychological, organizational, and personal stressors that could produce symptoms similar to those caused by poor indoor air quality.

Radon. A colorless, odorless gas that occurs naturally in almost all soil and rock. Radon migrates through the soil and groundwater and can enter buildings through cracks or other openings in the foundation. Radon can also enter through well water. Exposure to radon can cause lung cancer. See **Appendix G**: *Radon* for more information. See **Appendix E**: *Typical Indoor Air Pollutants* for more information.

Re-entry. Situation that occurs when the air being exhausted from a building is immediately brought back into the system through the air intake and other openings in the building envelope.

SBS. See "Sick Building Syndrome."

Sanitizer. One of three groups of anti-microbials registered by EPA for public health uses. EPA considers an antimicrobial to be a sanitizer when it reduces but does not necessarily eliminate all the microorganisms on a treated surface. To be a registered sanitizer, the test results for a product must show a reduction of at least 99.9% in the number of each test microorganism over the parallel control.

Secondhand Smoke. See **Appendix F**: *Secondhand Smoke* for more information.

Short-circuiting. Situation that occurs when the supply air flows to return or exhaust grilles before entering the breathing zone (area of a room where people are). To avoid short-circuiting, the supply air must be delivered at a temperature and velocity that results in mixing throughout the space.

Sick Building Syndrome. Term sometimes used to describe situations in which building occupants experience acute health and/or comfort effects that appear to be linked to time spent in a particular building, but where no specific illness or cause can be identified. The complaints may be localized in a particular room or zone, or may be spread throughout the building.

Soil Gases. Gases that enter a building from the surrounding ground (e.g., radon, volatile organic compounds, gases from pesticides in the soil).

Sources. Sources of indoor air pollutants. Indoor air pollutants can originate within the building or be drawn in from outdoors. Common sources include people, room furnishings such as carpeting, photocopiers, art supplies, etc. (see **Section 5** for more information).

Stack Effect. The flow of air that results from warm air rising, creating a positive pressure area at the top of a building and a negative pressure area at the bottom of a building. The stack effect can overpower the mechanical system and disrupt ventilation and circulation in a building.

Sterilizer. One of three groups of anti-microbials registered by EPA for public health uses. EPA considers an antimicrobial to be a sterilizer when it destroys or eliminates all forms of bacteria, fungi, viruses, and their spores. Because spores are considered the most difficult form of a microorganism to destroy, EPA considers the term sporicide to be synonymous with "sterilizer."

TVOCs. Total volatile organic compounds. See "Volatile Organic Compounds (VOCs)"

Unit Ventilator. A single fan-coil unit designed to satisfy tempering and ventilation requirements for individual rooms.

VOCs. See "Volatile Organic Compounds."

Ventilation Air. Defined as the total air, which is a combination of the air brought inside from outdoors and the air that is being recirculated within the building. Sometimes, however, used in reference only to the air brought into the system from the outdoors; this document defines this air as "outdoor air ventilation."

Volatile Organic Compounds (VOCs). Compounds that vaporize (become a gas) at room temperature. Common sources which may emit VOCs into indoor air include housekeeping and maintenance products, and building and furnishing materials. In sufficient quantities, VOCs can cause eye, nose, and throat irritations, headaches, dizziness, visual disorders, memory impairment; some are known to cause cancer in animals; some are suspected of causing, or are known to cause, cancer in humans. At present, not much is known about what health effects occur at the levels of VOCs typically found in public and commercial buildings. See **Appendix E:** *Typical Indoor Air Pollutants* for more information.

Zone. The occupied space or group of spaces within a building which has its heating or cooling controlled by a single thermostat.

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IAQ Coordinator Forms

Make copies of the Checklists and forms in this section so that the originals will be available for future use. The checklists and forms may be copied or modified according to your specific needs.

An electronic version may be downloaded from: www.epa.gov/iaq/schools.

The IAQ Coordinator's Forms behind this tab include:

- IAQ Coordinator's Checklist (2 pages)
- Checklists Log (1 page)
- Local IAQ Service Providers List (4 pages)
- Problem-Solving Checklist
- Activate the IAQ Managment Plan Checklist (2 pages)
- Sample Memo for School Staff
- Sample Memo for Parents
- Sample Memo for Contract Service Providers
- Sample Memo for Local News Media

Start-Up Hints

In addition to the Coordinator's Forms listed above, there is other information you should gather to make starting an IAQ program easier:

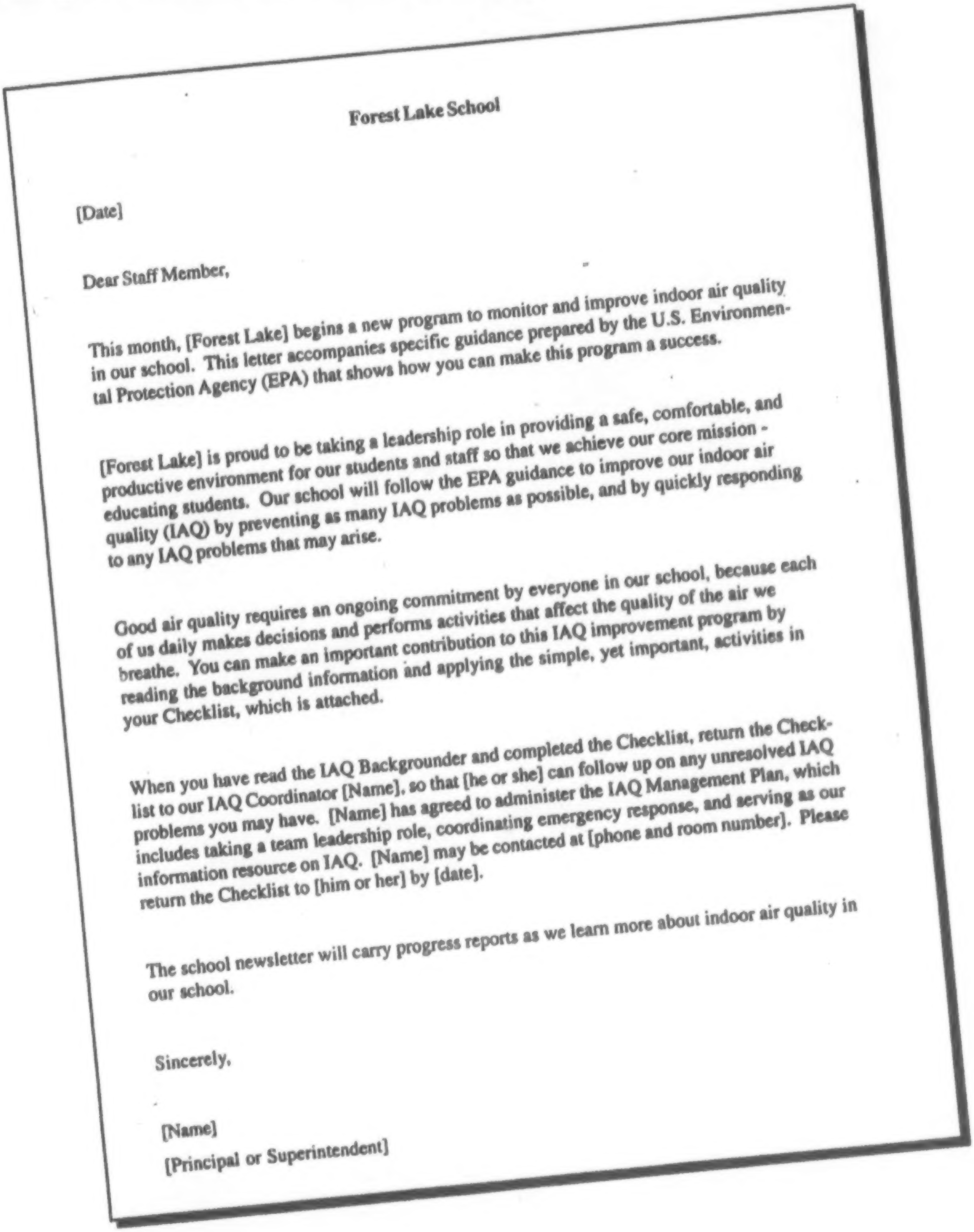
- Get a map/blueprint of the school (this will be invaluable).
- Count the number of staff and their job category, for example, the number of teachers, the number of maintenance staff, etc. (You'll need this information to distribute checklists to staff.)
- Obtain the names and contact information for any outside contractors the school uses, such as maintenance staff, or heating, ventilation, and air-conditioning contractors.

Before starting the program, some IAQ Coordinators have also found it useful to:

- Get support from the school and/or school district administration
- Read the IAQ Coordinator's Guide, especially pages 5-8
- Meet with the heating, ventilation, and air-conditioning technician to acquire a working knowledge of the various ventilation units at your school. Learn which systems serve which rooms.
- Set up a filing system for all the paperwork you will generate. Keep it in a convenient location. (Portable file boxes work nicely.) Set up a location for turning in Checklists.
- Set up an IAQ Resource Center at your school in an area where staff members can access information at their leisure. This is also a great place to post important reminders and communicate with your staff when something comes up.

And remember: Implementing an IAQ management program is an on-going process, not an overnight miracle. Be patient. Stay consistent, organized and never forget that you are doing something important for staff and students at your school.

Sample Memo for School Staff



Forest Lake School

[Date]

Dear Staff Member,

This month, [Forest Lake] begins a new program to monitor and improve indoor air quality in our school. This letter accompanies specific guidance prepared by the U.S. Environmental Protection Agency (EPA) that shows how you can make this program a success.

[Forest Lake] is proud to be taking a leadership role in providing a safe, comfortable, and productive environment for our students and staff so that we achieve our core mission - educating students. Our school will follow the EPA guidance to improve our indoor air quality (IAQ) by preventing as many IAQ problems as possible, and by quickly responding to any IAQ problems that may arise.

Good air quality requires an ongoing commitment by everyone in our school, because each of us daily makes decisions and performs activities that affect the quality of the air we breathe. You can make an important contribution to this IAQ improvement program by reading the background information and applying the simple, yet important, activities in your Checklist, which is attached.

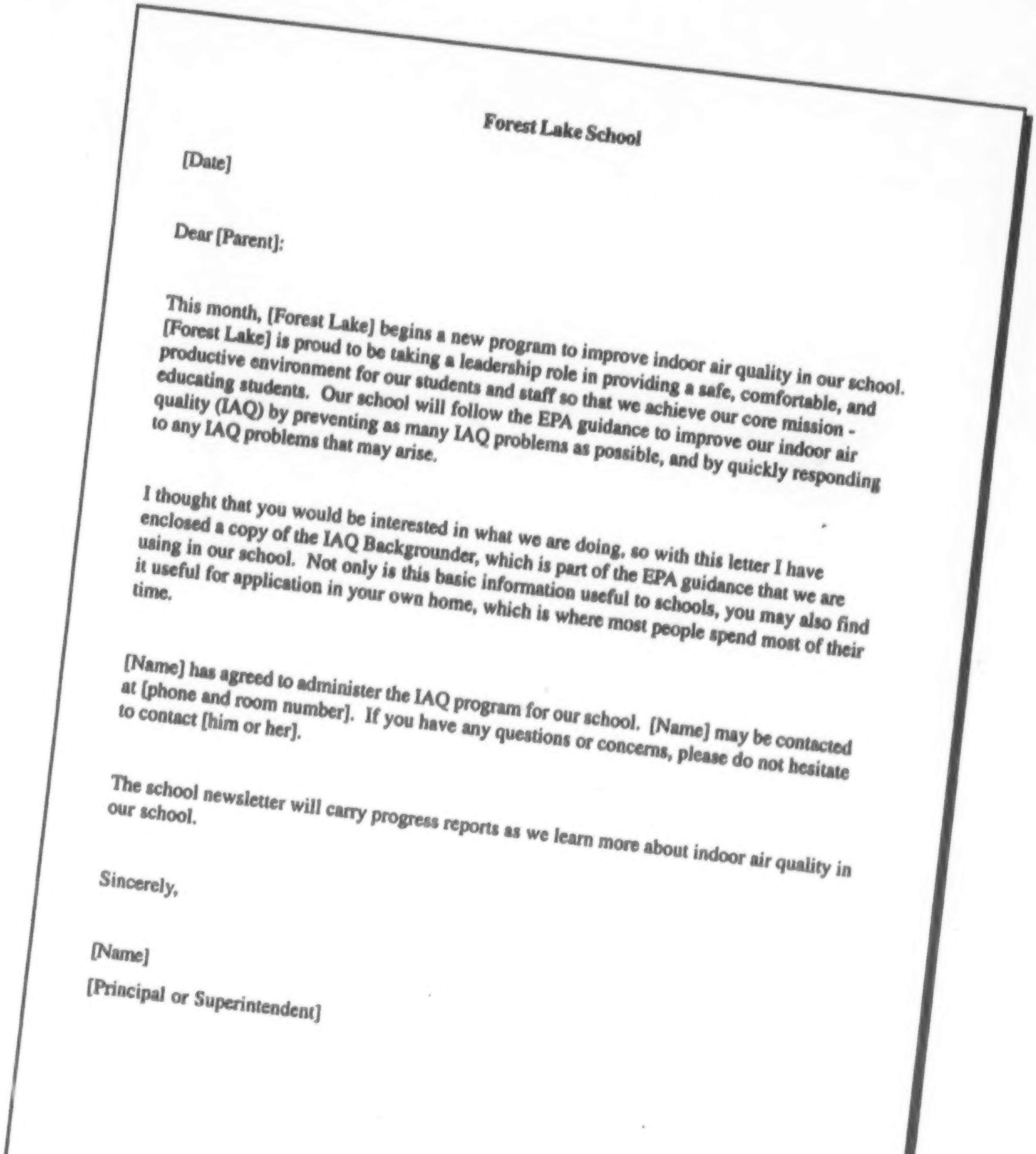
When you have read the IAQ Backgrounder and completed the Checklist, return the Checklist to our IAQ Coordinator [Name], so that [he or she] can follow up on any unresolved IAQ problems you may have. [Name] has agreed to administer the IAQ Management Plan, which includes taking a team leadership role, coordinating emergency response, and serving as our information resource on IAQ. [Name] may be contacted at [phone and room number]. Please return the Checklist to [him or her] by [date].

The school newsletter will carry progress reports as we learn more about indoor air quality in our school.

Sincerely,

[Name]
[Principal or Superintendent]

Sample Memo for Parents



Forest Lake School

[Date]

Dear [Parent]:

This month, [Forest Lake] begins a new program to improve indoor air quality in our school. [Forest Lake] is proud to be taking a leadership role in providing a safe, comfortable, and productive environment for our students and staff so that we achieve our core mission - educating students. Our school will follow the EPA guidance to improve our indoor air quality (IAQ) by preventing as many IAQ problems as possible, and by quickly responding to any IAQ problems that may arise.

I thought that you would be interested in what we are doing, so with this letter I have enclosed a copy of the IAQ Backgrounder, which is part of the EPA guidance that we are using in our school. Not only is this basic information useful to schools, you may also find it useful for application in your own home, which is where most people spend most of their time.

[Name] has agreed to administer the IAQ program for our school. [Name] may be contacted at [phone and room number]. If you have any questions or concerns, please do not hesitate to contact [him or her].

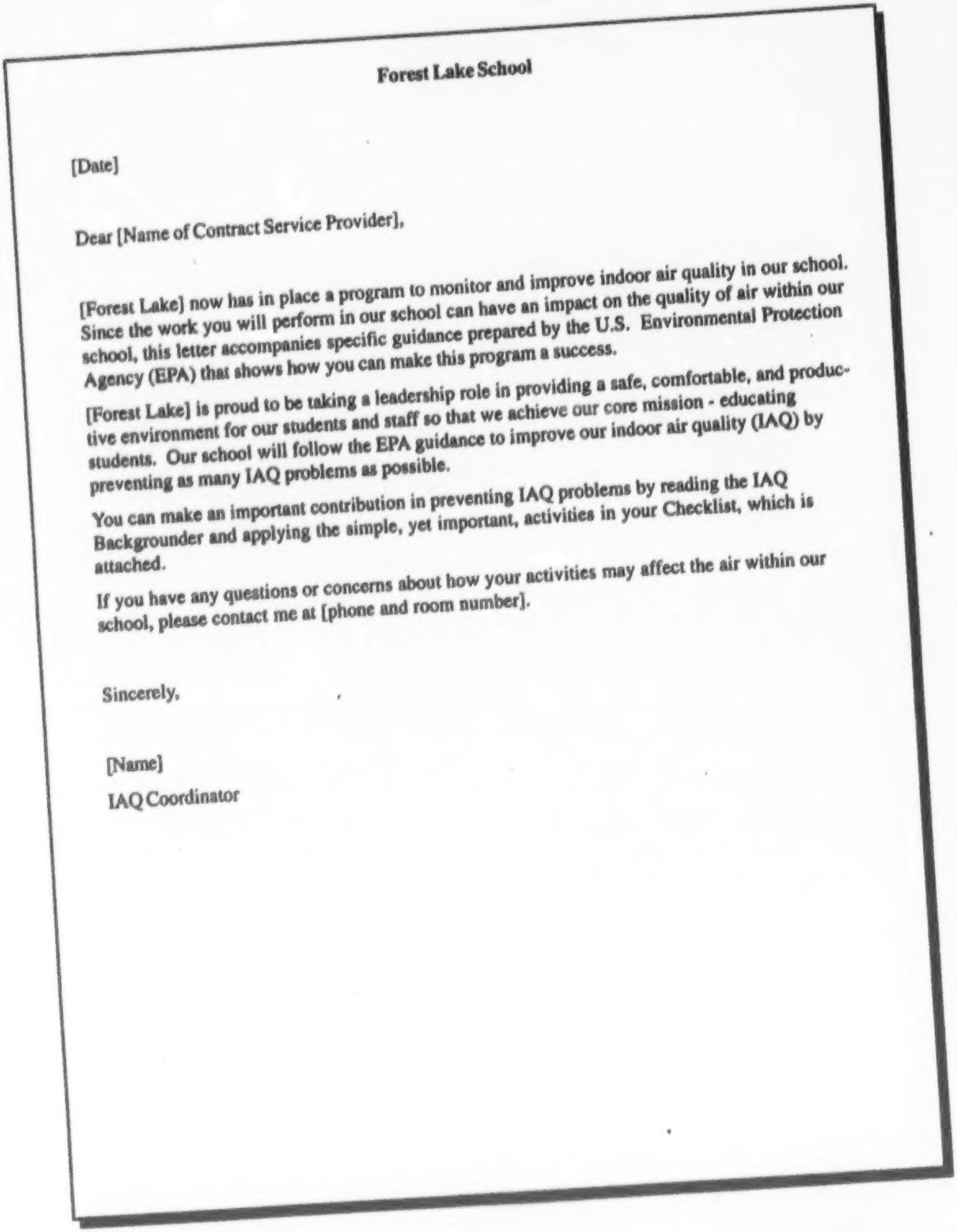
The school newsletter will carry progress reports as we learn more about indoor air quality in our school.

Sincerely,

[Name]

[Principal or Superintendent]

Sample Memo for Contract Service Providers



Forest Lake School

[Date]

Dear [Name of Contract Service Provider],

[Forest Lake] now has in place a program to monitor and improve indoor air quality in our school. Since the work you will perform in our school can have an impact on the quality of air within our school, this letter accompanies specific guidance prepared by the U.S. Environmental Protection Agency (EPA) that shows how you can make this program a success.

[Forest Lake] is proud to be taking a leadership role in providing a safe, comfortable, and productive environment for our students and staff so that we achieve our core mission - educating students. Our school will follow the EPA guidance to improve our indoor air quality (IAQ) by preventing as many IAQ problems as possible.

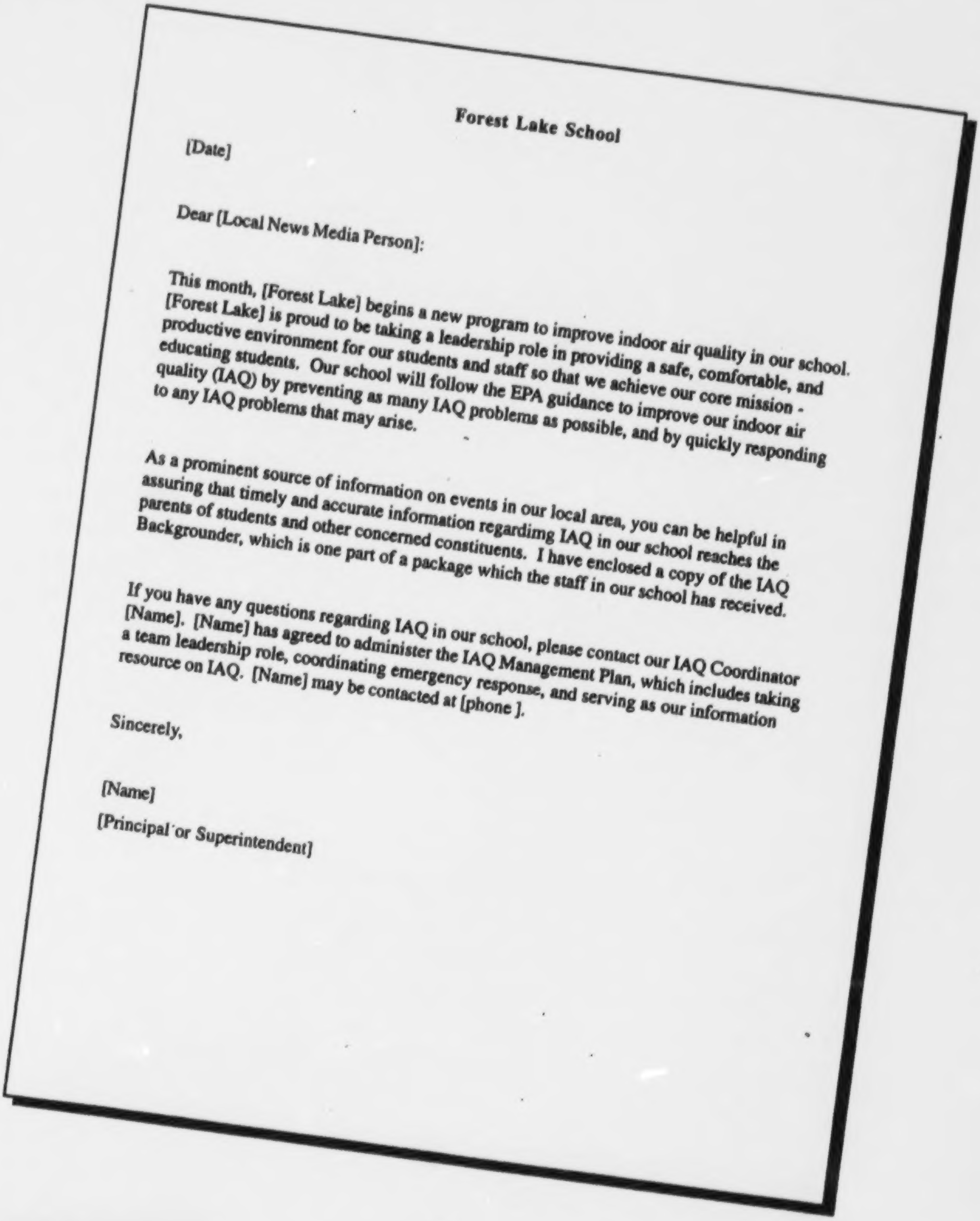
You can make an important contribution in preventing IAQ problems by reading the IAQ Backgrounder and applying the simple, yet important, activities in your Checklist, which is attached.

If you have any questions or concerns about how your activities may affect the air within our school, please contact me at [phone and room number].

Sincerely,

[Name]
IAQ Coordinator

Sample Memo for Local News Media



Forest Lake School

[Date]

Dear [Local News Media Person]:

This month, [Forest Lake] begins a new program to improve indoor air quality in our school. [Forest Lake] is proud to be taking a leadership role in providing a safe, comfortable, and productive environment for our students and staff so that we achieve our core mission - educating students. Our school will follow the EPA guidance to improve our indoor air quality (IAQ) by preventing as many IAQ problems as possible, and by quickly responding to any IAQ problems that may arise.

As a prominent source of information on events in our local area, you can be helpful in assuring that timely and accurate information regardimg IAQ in our school reaches the parents of students and other concerned constituents. I have enclosed a copy of the IAQ Backgrounder, which is one part of a package which the staff in our school has received.

If you have any questions regarding IAQ in our school, please contact our IAQ Coordinator [Name]. [Name] has agreed to administer the IAQ Management Plan, which includes taking a team leadership role, coordinating emergency response, and serving as our information resource on IAQ. [Name] may be contacted at [phone].

Sincerely,

[Name]

[Principal or Superintendent]

Activating the IAQ Management Plan

IAQ Coordinator	School	Date Completed

Use the checklist below to record and monitor the steps you have taken to activate the IAQ Management Plan.

Steps Taken	Date	Comments/Notes
1. IAQ Coordinator Selected Name:		
2. Guidance Read		
3. Administrative Support Obtained		
4. Requested Additional Information on Radon		
5. Requested Additional Information on Integrated Pest Management		
6. Requested Additional Information on Lead		
7. IAQ Checklist Interval Established # of times each year: Dates:		

Activating the IAQ Management Plan (page 2)

Steps Taken	Date	Comments/Notes
8. Emergency Response Prepared		
☐ Local health agency contacted		
☐ IAQ professional(s) identified and contacted		
☐ Equipment and supplies for wet carpets ready or local professional cleaning firm ready		
☐ Local IAQ Service Providers form filled in		
9. Committees and Groups Informed		
☐ Health and safety committee(s)		
☐ Building committee(s)		
☐ PTA		
☐ Others:		
10. IAQ Policies Prepared and Distributed		
☐ Smoking		
☐ Pest control		
☐ Ventilation system operation		
☐ Painting		
☐ Others:		

IAQ Coordinator's Checklist

IAQ Coordinator　　School　　Date Completed

Use the checklist below to record and monitor the steps you have taken to implement the IAQ Management Plan.

Steps Taken	Date	Comments/Notes
1. Start Action Packets Log		
2. Distribute Action Packets		
☐ All appropriate people have received an Action Packet		
☐ Each Action Packet type has been distributed		
3. Receive and Summarize IAQ Checklists		
☐ Receive all IAQ Checklists		
☐ Review IAQ Checklists		
☐ Transfer data to Checklists Log		
☐ List things to review during walk-through inspection		
4. Perform Walkthrough with walkthrough checklist		
5. Assess Radon Status		
☐ Testing completed		
☐ Control system installed (if needed)		
☐ Control system properly operating		
6. Assess Pest Control		
7. Assess Lead Status		
8. Identify Recent Changes		
☐ Flooding/water damage		
☐ Night or weekend classes		
☐ New staff		
☐ Other		

IAQ Coordinator's Checklist (page 2)

Steps Taken	Date	Comments/Notes
9. **Set Repair and Upgrade Priorities** ☐ Make to-do list		
10. **Gain Approval for Repairs and Upgrades**		
11. **Distribute Status Report**		
12. **Perform Repairs and Upgrades**		
13. **Conduct Follow-up Inspections**		
14. **Develop Calendar of IAQ Events**		
☐ Set next date for applying IAQ checklist		
☐ Note upcoming renovation and repairs		
☐ Note future addition of staff		
15. **Assess Problem Solving Performance**		
16. **Establish and Update IAQ Policies**		
17. **Distribute Final Report** ☐ Students and staff		
☐ Parents		
☐ School administration		
18. **Check Contacts List**		
19. **File Checklists, Reports, and Notes**		

Checklists Log

IAQ Coordinator ____________________ School ____________________

Use this log to keep track of who has received a Checklist, who has returned their Checklist(s), unresolved problem(s) identified in the Checklist(s), who solved the problems, and when.

This log can also be used to record distribution of information to parents, school board members, contract service providers, and local media.

Person Receiving Checklist	Location or Room #	Type of Checklist(s) Distributed								Date		Problems Require Follow-up	Follow-up Delegated To	Date Completed
		Teachers' Classroom	Administrative Staff	Health Officer/School Nurse	Ventilation	Building Maintenance	Food Service	Waste Management	Renovation and Repairs	Sent	Received			
												☐ Yes ☐ No		
												☐ Yes ☐ No		
												☐ Yes ☐ No		
												☐ Yes ☐ No		
												☐ Yes ☐ No		
												☐ Yes ☐ No		
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												☐ Yes ☐ No		
												☐ Yes ☐ No		

Local IAQ Service Providers List

Hazardous Materials Hotline	FIRM	CONTACT	PHONE	ADDRESS
		TITLE	EMERGENCY	
Local Health Department	FIRM	CONTACT	PHONE	ADDRESS
		TITLE	EMERGENCY	
State Health Department	FIRM	CONTACT	PHONE	ADDRESS
		TITLE	EMERGENCY	
Carpet Cleaner	FIRM	CONTACT	PHONE	ADDRESS
		TITLE	EMERGENCY	
IAQ Consultant	FIRM	CONTACT	PHONE	ADDRESS
		TITLE	EMERGENCY	
Mechanical Systems Operator	FIRM	CONTACT	PHONE	ADDRESS
		TITLE	EMERGENCY	
	FIRM	CONTACT	PHONE	ADDRESS
		TITLE	EMERGENCY	
	FIRM	CONTACT	PHONE	ADDRESS
		TITLE	EMERGENCY	
	FIRM	CONTACT	PHONE	ADDRESS
		TITLE	EMERGENCY	
	FIRM	CONTACT	PHONE	ADDRESS
		TITLE	EMERGENCY	

Problem Solving Checklist

Use this Checklist with the IAQ Problem Solving Wheel to resolve a single IAQ complaint, or several complaints occurring at the same time that seem related. Mark a copy of the fire escape floorplan or use other means of recording and reviewing information. Since this Checklist becomes a record of your activities in resolving an IAQ complaint(s), date it and file it for future reference. Involve additional staff, such as engineers, during the problem solving process.

IAQ Coordinator ____________________

School ____________________

Complaint Data

Record complaints below at the beginning of your problem solving process. Interview the complainant(s) to get a complete and accurate description of the complaint symptoms, times, and locations.

Complainant Name	Date Received	Description of Complaint (symptoms or explanation)	Location(s) or Room Number(s)	Is Problem Ongoing?	Occurence Date(s) & Time(s)
				☐Y ☐N	
				☐Y ☐N	
				☐Y ☐N	
				☐Y ☐N	
				☐Y ☐N	
				☐Y ☐N	
				☐Y ☐N	
				☐Y ☐N	
				☐Y ☐N	

Problem Solving Steps

Follow the directions on the IAQ Problem Solving Wheel to investigate potential causes of the symptoms recorded above. Use the steps below to help keep your investigation organized and documented.

Step	Date Completed	Notes
1. Relate the symptoms from the complaint data box to a group of symptoms in the Notes column to the right		☐ Odors ☐ Temperature or humidity problems (occupant discomfort) ☐ Headache, lethargy, nausea, drowsiness, and dizziness ☐ Swelling, itching, or irritated eyes, nose, or throat; congestion ☐ Cough; congestion; chest tightness; shortness of breath; fever; chills and/or fatigue ☐ Diagnosed infection or clusters of serious health problems

Step	Date Completed	Notes
2. Is this an emergency? ☐ Yes ☐ No See the Wheel sectors "Identifying an emergency" and "What to do in an emergency"		Actions Taken: ☐ Evacuation ☐ Notification ☐ Other:
3. Place a checkmark next to the potential causes in Step 4 below that are shown at 2 on the Wheel.		

4. Each section below corresponds to a section of the IAQ Problem Solving Wheel. Use this area to record diagnostics you perform. Three spaces are provided below for each diagnostic step to allow you to record information for more than one location or piece of equipment. Make extra copies of this form as necessary. Please note that some of the steps may not apply to your building.

Step	Date completed (for each location if more than one location or piece of equipment is involved)			Notes
	1	2	3	
☐ Temperature & Humidity ▪ Is thermostat properly set? ▪ Is air flowing from the vent warm (for heat) or cool (for air conditioning)? ▪ Are drafts or direct sunlight causing discomfort? ▪ Is humidity too high or low (best if between 30-60% rel. humidity)? ▪ Is condensation often present on windows or other cold surfaces? ▪ Is there an objectionable odor?				
☐ Outdoor Air Supply ▪ Is ventilation system turned on? ▪ Is outdoor intake blocked? ▪ Are supply vent(s) blocked? ▪ Is air flowing from supply vent(s)? ▪ Is air flowing into outdoor intake? ▪ Are outdoor air or supply ducts blocked? ▪ Is outdoor air supply at least 15 cfm per person? ▪ Is CO_2 in the area higher than 1000 ppm?				
☐ Air Handling Unit ▪ Is the system turned on? ▪ Is the air flowing from vent(s)? ▪ Is the fan operating? ▪ Is the filter(s) clean & properly installed? ▪ Are dampers operating properly? ▪ Is there moisture, debris or microbial growth in or around the unit? ▪ Is the drain pan clean & draining? ▪ Are the coils clean? ▪ Is combustion equipment properly vented (no flue leaks, spillage, or backdrafting)?				

Step	Date completed (for each location if more than one location or piece of equipment is involved)			Notes
	1	2	3	
☐ **Local Exhaust**				
▪ Does exhaust turn on?				
▪ Is the exhaust used when needed?				
▪ Is air flowing out the exhaust vent?				
▪ Is exhaust duct work blocked?				
▪ Is a sufficient amount of air being exhausted?				
▪ If everything works, but not enough air is being exhausted, can make up air easily enter the room (e.g., through spaces under doors)?				
☐ **Biological Sources**				
▪ Are animals or fungi (mold) present?				
▪ Is there an odor of mold or mildew in or near the complaint area?				
▪ Is there standing water near the complaint area or in the air handling unit?				
▪ Is condensation often present on window or cold surfaces?				
▪ Is indoor relative humidity above 60%?				
▪ Are contagious occupants present?				
☐ **Housekeeping Sources**				
▪ Do complaints occur during or just after housekeeping activities?				
▪ Do housekeeping activities take place near the complainants?				
▪ Are any new products in use?				
▪ Are housekeeping products being used according to directions?				
▪ Are products stored in sealed containers or in a vented room(s)?				
☐ **Outdoor Sources**				
▪ Are sources of odor or pollutants (e.g., vehicles, stored chemicals, trash, plumbing vents) located near outdoor air intakes?				
▪ Are there sources nearby or upwind:				
• Combustion byproducts from traffic, loading docks, or flue exhausts?				
• Industrial, agricultural, or lawn care activity?				
• Construction activity?				
▪ Are pollen levels high?				
☐ **Building Sources**				
▪ Has there been recent painting,roofing, or other remodeling or construction?				
▪ Were pesticides applied recently near the complaint area?				
▪ Are new furnishings or equipment in place?				
▪ Are drain traps dry?				
▪ Are chemicals stored in poorly sealed containers?				
▪ Is it overly dusty?				

Step	Date Completed	Notes
5. Repeat all diagnostics for each potential cause in all affected locations.		
6. If the diagnostics for the recommended potential causes did not identify the problem(s), investigate remaining potential causes in Step 4 until the cause(s) of the complaint(s) are identified and corrected.		
7. If problem remains unidentified or uncorrected, obtain professional assistance.		Company: Person: Phone:
8. Provide notice if problem is not quickly resolved.		☐ Notice to Occupants ☐ Notice to parents of minors
9. Problem resolved and preventive measures taken.		Describe solution: ☐ Preventive measures taken:
10. Provide a final report.		☐ Final report to occupants ☐ Final report to parents of minors
11. To prevent future problems implement an IAQ Management Plan.		
12. File this Checklist and related information.		☐ Done

IAQ Backgrounder

Indoor Air Quality

Tools for Schools

Good indoor air quality contributes to a favorable learning environment for students, performance of teachers and staff, and a sense of comfort, health and well-being for all school occupants. These combine to assist a school in its core mission - educating children.

The goal of the Checklist is to provide clear and easily applied activities that you can use to help prevent indoor air quality problems and resolve any problems promptly if they do arise. Once you understand the basic principles and factors that influence indoor air quality in your school, you will note that the specific activities involve two major actions - the management of pollutant sources, and the use of ventilation for pollutant control. This guidance is based on the following principles:

- Many IAQ problems can be prevented by school staff and students.
- When IAQ problems do arise, they can often be resolved using the skills of school staff.
- The expense and effort required to prevent most IAQ problems is much less than the expense and effort required to resolve problems after they develop.

Why IAQ is Important to Your School

Most people are aware that outdoor air pollution can damage their health, but many do not know that indoor air pollution can also have significant harmful effects. U.S. Environmental Protection Agency (EPA) studies of human exposure to air pollutants indicate that indoor levels of pollutants may be 2-5 times, and occasionally more than 100 times, higher than outdoor levels. These levels of indoor air pollutants may be of particular concern because it is estimated that most people spend about 90% of their time indoors. Comparative risk studies performed by EPA and its Science Advisory Board have consistently ranked indoor air pollution among the top five environmental health risks to the public.

Failure to prevent indoor air problems, or failure to respond promptly, can have consequences such as:

- increasing the potential for long term and short term health problems for students and staff
- impacting the student learning environment, comfort, and attendance
- reducing performance of teachers and staff due to discomfort, sickness, or absenteeism
- accelerating deterioration and reducing efficiency of the school physical plant and equipment
- increasing the potential that schools will have to be closed, or occupants temporarily relocated
- straining relationships among school administration and parents and staff
- creating negative publicity that could damage a school's or administration's image and effectiveness
- creating potential liability problems

Indoor air problems can be subtle and do not always produce easily recognized impacts on health, well-being, or the physical plant. Children may be especially susceptible to air pollution. For this and the reasons noted above, air quality in schools is of particular concern - proper maintenance of indoor air is more than a "quality" issue, it encompasses safety and stewardship of our investment in the students, staff, and facilities.

Understanding IAQ Problems and Solutions

Over the past several decades, exposure to indoor air pollutants has increased due to a variety of factors, including the construction of more tightly sealed buildings, reduced ventilation rates to save energy, the use of synthetic building materials and furnishings, and the use of chemically-formulated personal care products, pesticides, and housekeeping supplies. In addition, our activities and our decisions, such as deferring maintenance to "save" money, lead to problems from sources and ventilation.

Four basic factors affect IAQ: sources of indoor air pollutants, heating, ventilation, and air-conditioning (HVAC) system, pollutant pathways, and occupants.

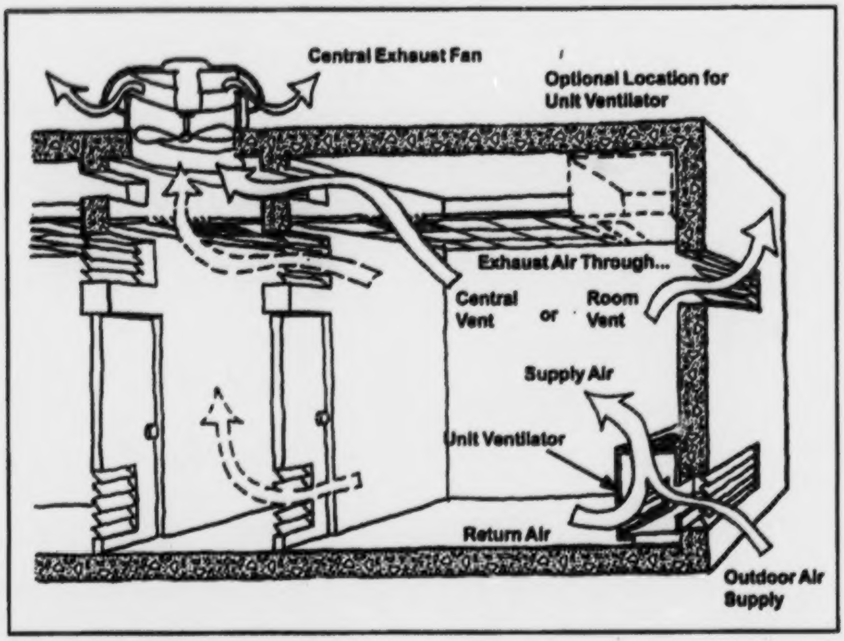
Sources of Indoor Air Pollutants

Indoor air contaminants can originate within the building or be drawn in from outdoors. If pollutant sources are not controlled, IAQ problems can arise, even if the HVAC system is properly operating. Air pollutants consist of numerous particulates, fibers, mists, bioaerosols, and gases. It may be helpful to think of air pollutant sources as fitting into one of the categories in the table shown below.

In addition to the number of potential pollutants, another complicating factor is that indoor air pollutant concentration levels can vary by time and location within the school building, or even a single classroom. Pollutants can be emitted from point sources, such as from science store rooms, or from area sources, such as newly painted surfaces, and pollutants can vary with time, such as only once each week when floor stripping is done, or continuously such as fungi growing in the HVAC system.

Typical Sources of Indoor Air Pollutants

Outside Sources	Building Equipment	Components/Furnishings	Other Indoor Sources
Polluted Outdoor Air • Pollen, dust, fungal spores • Industrial emissions • Vehicle emissions **Nearby Sources** • Loading docks • Odors from dumpsters • Unsanitary debris or building exhausts near outdoor air intakes **Underground Sources** • Radon • Pesticides • Leakage from underground storage tanks	**HVAC Equipment** • Microbiological growth in drip pans, ductwork, coils, and humidifiers • Improper venting of combustion products • Dust or debris in ductwork **Non-HVAC Equipment** • Emissions from office equipment (volatile organic compounds, ozone) • Emissions from shops, labs, cleaning processes	**Components** • Microbiological growth on soiled or water-damaged materials • Dry traps that allow the passage of sewer gas • Materials containing volatile organic compounds, inorganic compounds, or damaged asbestos • Materials that produce particles (dust) **Furnishings** • Emissions from new furnishings and floorings • Microbiological growth on or in soiled or water-damaged furnishings	• Science laboratories • Vocational arts areas • Copy/print areas • Food prep areas • Smoking lounges • Cleaning materials • Emissions from trash • Pesticides • Odors and volatile organic compounds from paint, chalk, adhesives • Occupants with communicable diseases • Dry-erase markers and similar pens • Insects and other pests • Personal care products


Central Exhaust Fan
Optional Location for Unit Ventilator
Exhaust Air Through...
Central Vent
or
Room Vent
Supply Air
Unit Ventilator
Return Air
Outdoor Air Supply

How outdoor air is supplied through a unit ventilator.

HVAC System Design and Operation

The heating, ventilation, and air-conditioning (HVAC) system includes all heating, cooling, and ventilating equipment serving a school. A properly designed and functioning HVAC system:

- controls temperature and humidity to provide thermal comfort
- distributes adequate amounts of outdoor air to meet ventilation needs of school occupants
- isolates and removes odors and pollutants through pressure control, filtration, and exhaust fans

Not all HVAC systems are designed to accomplish all of these functions. Some buildings rely only on natural ventilation. Others lack mechanical cooling equipment, and many function with little or no humidity control. The two most common HVAC designs used in schools are unit ventilators and central air handling systems. Both can perform the same HVAC functions, but the central air handling unit serves multiple rooms while the unit ventilator serves a single room.

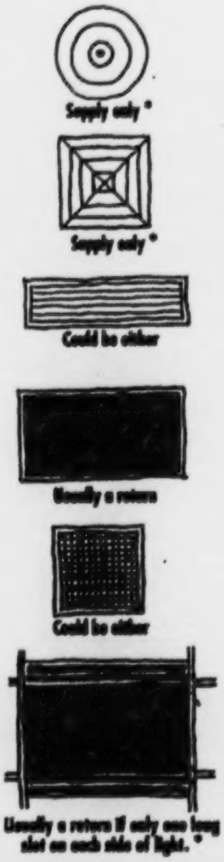
The three building figures in this Backgrounder show typical methods for how outdoor air enters a room, and how exhaust air exits through a vent. If exhaust airflow through door or wall grilles into corridors is sealed due to fire codes, ensure that air has another path to reach the central exhaust.

Pollutant Pathways and Driving Forces

Airflow patterns in buildings result from the combined forces of mechanical ventilation systems, human activity, and natural effects. Air pressure differences created by these forces move airborne pollutants from areas of higher pressure to areas of lower pressure through any available openings in building walls, ceilings, floors, doors, windows, and HVAC system. An inflated balloon is an example of this driving force. As long as the opening to the balloon is kept shut, no air will flow, but when open, air will move from inside (area of higher pressure) to the outside (area of lower pressure).

Even if the opening is small, air will move until the pressures inside and outside are equal.

Typical supply vents and return/exhaust grilles.


Supply only *
Supply only *
Could be either
Usually a return
Could be either
Usually a return if only one long slot on each side of light. *

*located only on ceilings, not walls

Building Occupants

Building occupants in schools include the staff, students, and other people who spend extended periods of time in the school. The effects of IAQ problems on occupants are often non-specific symptoms rather than clearly defined illnesses. Symptoms commonly attributed to IAQ problems include:

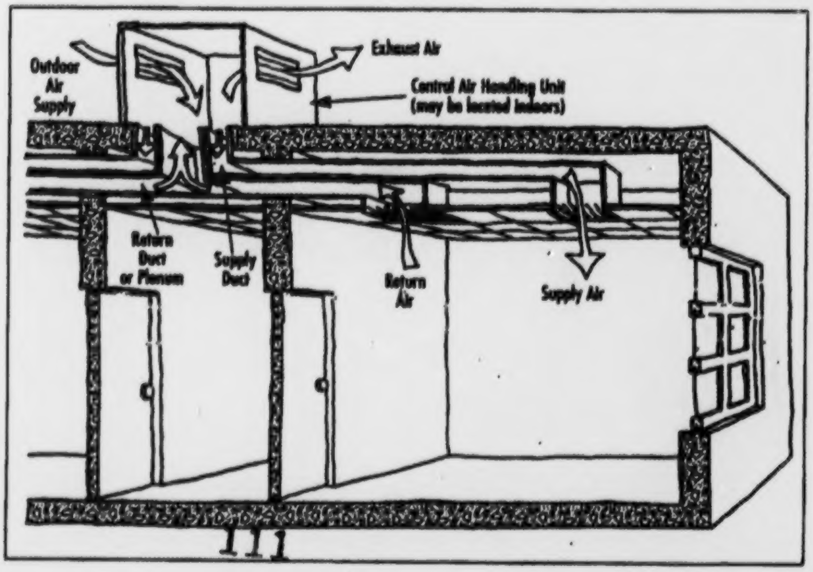
- headache, fatigue, and shortness of breath
- sinus congestion, cough, and sneezing
- eye, nose, throat, and skin irritation
- dizziness and nausea

All of these symptoms, however, may also be caused by other factors, and are not necessarily due to air quality deficiencies. Environmental stressors such as improper lighting, noise, vibration, overcrowding, poor ergonomics, and psychosocial problems (such as job or home stress) can produce symptoms that are similar to those associated with poor air quality, but require different solutions.

Because of varying sensitivity among people, one individual may react to a particular IAQ problem while surrounding occupants do not display ill effects. In other cases, complaints may be widespread. In addition to different degrees of reaction, an indoor air pollutant or problem can trigger different types of reactions in different people. Groups that may be particularly susceptible to effects of indoor air contaminants include, but are not limited to:

- allergic or asthmatic individuals, or people with sensitivity to chemicals
- people with respiratory disease
- people whose immune systems are suppressed due to radiation, chemotherapy, or disease
- contact lens wearers

How outdoor air is supplied in a central air handling system.



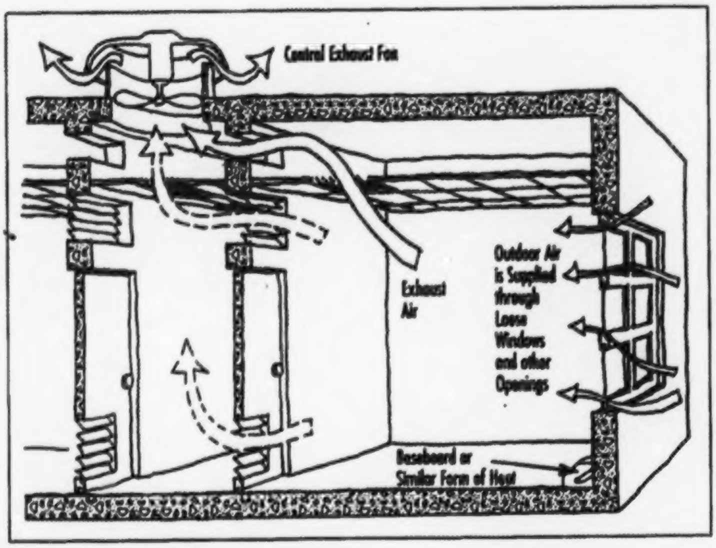
Six Basic Control Strategies

There are six basic control methods for lowering concentrations of indoor air pollutants. Specific applications of these basic control strategies are noted in your Checklists.

Source Management includes source removal, source substitution, and source encapsulation. Source management is the most effective control method when it can be practically applied. Source removal is very effective. However, policies and actions that keep potential pollutants from entering the school are even better at preventing IAQ problems. Examples of source removal include not allowing buses to idle near outdoor air intakes, not placing garbage in rooms with HVAC equipment, and banning smoking within the school. Source substitution includes actions such as selecting a less toxic art material or interior paint than the products which are currently in use. Source encapsulation involves placing a barrier around the source so that it releases fewer pollutants into the indoor air (e.g., asbestos abatement, pressed wood cabinetry with sealed or laminated surfaces).

Local Exhaust is very effective in removing point sources of pollutants before they can disperse into the indoor air by exhausting the contaminated air outside. Well known examples include restrooms and kitchens where local exhaust is used. Other examples of pollutants that originate at specific points and that can be easily exhausted include science lab and housekeeping storage rooms, printing and duplicating rooms, and vocational/ industrial areas such as welding booths.

Ventilation through use of cleaner (outdoor) air to dilute the polluted (indoor) air that people are breathing. Generally, local building codes specify the quantity (and sometimes quality) of outdoor air that must be continuously supplied to an occupied area. For situations such as painting, pesticide application, or chemical spills, temporarily increasing the ventilation can be useful in diluting the concentration of noxious fumes in the air.


Central Exhaust Fan
Exhaust Air
Outdoor Air is Supplied through Loose Windows and other Openings
Baseboard or Similar Form of Heat

How outdoor air is supplied in an exhaust-only system.

Exposure Control includes adjusting the time of use and location of use. An example of time of use would be to strip and wax floors on Friday after school is dismissed, so that the floor products have a chance to off-gas over the weekend, reducing the level of odors or contaminants in the air when the school is occupied. Location of use deals with moving the contaminating source as far as possible from occupants, or relocating susceptible occupants.

Air Cleaning primarily involves the filtration of particles from the air as the air passes through the ventilation equipment. Gaseous contaminants can also be removed, but in most cases this type of system should be engineered on a case-by-case basis.

IAQ Checklists Available

- Teacher's
- Administrative Staff
- Health Officer's
- Ventilation
- Building Maintenance
- Food Service
- Waste Management
- Renovation and Repairs
- Walkthrough

Education of the school occupants regarding IAQ is critical. If people are provided information about the sources and effects of contaminants under their control, and about the proper operation of the ventilation system, they will better understand their indoor environment and can act to reduce their personal exposure.

Your Role in the IAQ Team

As one of the people in your school, your activities and decisions have an impact on the quality of the indoor air in your school. You can participate by applying the activities noted in your Checklist, and by continuing to apply these principles on a daily basis. Someone from your school or district has taken the role of IAQ Coordinator, and serves as a focal point for collecting IAQ information and handling IAQ concerns.

How Do You Know if You Have an IAQ Problem

Diagnosing symptoms that relate to IAQ can be tricky. Acute (short-term) symptoms of IAQ problems typically are similar to those from colds, allergies, fatigue, or the flu. There are clues that can serve as an indicator of a potential indoor air problem:

- the symptoms are widespread within a class or within the school
- the symptoms disappear when the students or staff leave the school building for a day
- the onset is sudden after some change at school, such as painting or pesticide application
- persons with allergies, asthma, or chemical sensitivities have reactions indoors but not outdoors
- a doctor has found that a student or staff member has an indoor air-related illness

However, a lack of symptoms does not ensure that IAQ is acceptable. Symptoms from long-term health effects (such as lung cancer due to radon) often do not become evident for many years.

What if You Think You Have an IAQ Problem

If you receive complaints that seem to indicate a potential IAQ problem and the problem is self-evident, then attempt to correct the problem. If the problem cannot be corrected, or if the complaint seems to indicate a potentially severe IAQ problem, contact the IAQ Coordinator immediately. The IAQ Coordinator may ask you questions to try to identify whether you have overlooked potential causes of the problem (such as, "Has anything changed since the last time you completed your Checklist?"), and then may call in other help from within or outside the school to investigate further.

Communication

Because indoor air problems can jeopardize the health of students and staff, parents and the public may react strongly to reports of bad indoor air quality in your school. With this in mind, it is recommended that you follow the communications guidelines established by the IAQ Coordinator. Usually, this will involve referring questions from the public and media to one central source, the IAQ Coordinator for your school. In this way, students, parents, staff, and the public will not become alarmed by conflicting or wrong information, and will have a consistent and complete source of information regarding the quality of the indoor air in your school.

Teacher's Classroom Checklist

IAQ tools For Schools

Instructions:

1. Read the *IAQ Backgrounder* and the information in this section.
2. Put a "check" in the "yes" or "no" box beside each item as appropriate.
3. Make comments as desired in the "Notes" section.
4. If any "no" boxes are checked, put a check in the circle beside the "need help" statement.
5. Return this checklist to the IAQ Coordinator and keep a copy for future reference.

Name:

Room or Area:

School:

Date Completed:

Signature:

GENERAL CLEANLINESS

Regular and thorough classroom cleaning is important to ensure good indoor air quality. While custodians typically clean the classroom, as a teacher you also can play an important role in promoting and maintaining classroom cleanliness. The presence of dirt, moisture, and warmth also stimulates the growth of molds and other biological contaminants. Unsanitary conditions attract insects and vermin, leading to possible indoor air quality (IAQ) problems from animal or insect allergens. The overuse or improper use of pesticides for secondary control of insects, vermin, and head lice can cause IAQ problems.

Reminder: Clean spills promptly

- For spills on carpets, contact custodial staff immediately (carpets need to be cleaned properly, and dried within 24 hours to prevent mold growth)
- Request that unit ventilator be cleaned and filter replaced if spilled liquid goes into the unit
- Report previous spills on carpets or in unit ventilators because they can affect current indoor air quality

☐Y ☐N Classroom is clean

☐Y ☐N Classroom is dusted and vacuumed thoroughly and regularly

☐Y ☐N Trash is removed daily

☐Y ☐N Food is not kept in classroom overnight

☐Y ☐N Animal food, if any, is stored in tightly sealed containers

☐Y ☐N Room is free of pests

☐Y ☐N Room is free of the use of scented cleaners

☐Y ☐N Spills cleaned

○ **Need help with cleaning or pest control**

Notes ______________________

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ANIMALS IN THE CLASSROOM

Certain individuals, in particular those with asthma, are sensitive to animal fur, dander, body fluids and feces, and may experience reactions to these allergens. Furthermore, individuals can become sensitized (made allergic) by repeated exposure to animal allergens.

☐Y ☐N Exposure to animal allergens minimized.

☐Y ☐N Animals kept in cages as much as possible; not allowed to roam

☐Y ☐N Cages cleaned regularly

☐Y ☐N Animals located away from ventilation system vents to avoid circulating allergens throughout the room or building

☐Y ☐N Alternatives to animals used when possible

○ **Need help minimizing exposure to animal allergens**

Take special care with asthmatic or other sensitive students

☐Y ☐N School nurse consulted about student allergies or sensitivities (privacy laws may limit the information that health officials can disclose)

☐Y ☐N Parents asked about potential allergies in a note that students take home, or during parent teacher conferences

☐Y ☐N Check for allergies when new students enter the class

☐Y ☐N Sensitive students located away from animals and habitats

○ **Need help determining if students have allergies**

Notes________________________

____

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____

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DRAIN TRAPS IN THE CLASSROOM

Drain traps, if present, can become a problem when the water in the drain trap evaporates due to infrequent use, allowing sewer gases to enter the room.

☐Y ☐N Drain traps filled regularly

☐Y ☐N Water poured down floor drains once per week (approx. 1 quart of water)

☐Y ☐N Water run in sinks at least once per week (about 2 cups of water)

☐Y ☐N If not regularly used, toilets flushed once each week

○ **Need help filling dry drain traps regularly**

Notes________________________

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EXCESS MOISTURE IN CLASSROOMS

Excess moisture contributes to mold growth. Mold can trigger allergic reactions and asthma in sensitive individuals. Mold can also cause odors and other IAQ problems. Excess moisture is the result of condensation on cold surfaces, leaking or spilled liquid, or excess humidity. Note here any signs of moisture that exist now or that recur.

Condensate (condensed water, or "fog") on cold surfaces

☐Y ☐N Windows, window sills, and window frames free of condensate

☐Y ☐N Cold water pipes free of condensate

☐Y ☐N Indoor surfaces of exterior walls free of condensate

○ **Excess condensate found**

Check for leaks or signs of moisture from plumbing or roofs

☐Y ☐N Area around and under classroom sinks free of leaks

☐Y ☐N Classroom lavatories free of leaks

☐Y ☐N Ceiling tiles or walls leak-free (discoloration may indicate periodic leaks)

○ **Found leaks or signs of moisture**

Notes ______________________

____

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THERMAL COMFORT

Temperature and relative humidity can affect comfort and IAQ. Changing thermostat settings or opening windows to try to control temporary fluctuations in temperature can worsen comfort problems and also have an adverse effect on other parts of the school.

Check comfort factors

☐Y ☐N Temperature (generally 72°F-76°F)

☐Y ☐N No signs of draftiness

☐Y ☐N No direct sunlight shining on students

☐Y ☐N Humidity is acceptable. (typically, too high if higher than 60% relative humidity [RH]–or too low if lower than 30% relative humidity)

☐Y ☐N Room usually comfortable

○ **Need help, room frequently uncomfortable**

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VENTILATION

Ventilation is the process by which stale indoor air is exhausted to the outside, and outdoor air is drawn into the building. You may either have mechanical ventilation (supplied by fans) or natural ventilation (i.e., operable windows).

Determine how your classroom is ventilated (see IAQ Backgrounder)

☐Y ☐N Unit ventilator located

☐Y ☐N Air supply and return vents located

☐Y ☐N Windows are operable

○ **Need help determining type of ventilation**

If you have mechanical ventilation, confirm that air is flowing into the room from the air supply vent(s)

Check for airflow by holding a piece of tissue paper near the air supply vent(s); if air is flowing, the tissue will flutter away from the supply vent. Make sure that the airflow is not diverted or obstructed by books, papers, furniture, or other obstacles. Never place anything on top of unit ventilators.

☐Y ☐N Air is flowing from air supply

○ **Need help, supply air is not flowing**

If you have mechanical ventilation, confirm that air is flowing from the room into the air return grille(s)

Check for airflow at air return grille(s) in the same manner as with previous activity. If air is flowing, the plastic or tissue will be pulled toward the return. A piece of plastic that nearly covers the grille will stick to the face of the grille if air is flowing. Make sure airflow is not obstructed by books, papers, furniture, or other obstacles.

☐Y ☐N Air is flowing without obstruction

○ **Need help, exhaust air is not flowing**

Check for unexplained odors

Improperly operated or poorly maintained ventilation systems may cause IAQ problems. Odors, or the need to use scented air fresheners, may indicate a ventilation problem. The ventilation system can carry air contaminants from another location in the school to your classroom.

☐Y ☐N No smell of vehicle exhaust

☐Y ☐N No smell of kitchen/food

☐Y ☐N No smell of "chemicals"

☐Y ☐N No smell of mold or mildew

☐Y ☐N Found source of odors and corrected problem

○ **Need help, sometimes smell unexplained or unpleasant odors in classroom**

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NOTE: Conduct the following activities as appropriate to your classroom.

LOCAL EXHAUST FANS

Local exhaust fans and fume hoods can be used to prevent air pollutants and moisture from accumulating in, or spreading beyond, the local area or classroom. Local exhaust fans may be used to exhaust entire rooms (e.g., bathrooms or locker rooms). Fume hoods are appropriate for activities that generate significant quantities of pollutants in a local area within a room (e.g., science experiments, spray painting, and welding).

- Determine if your classroom activities generate air pollutants and whether your classroom is equipped with local exhaust fans and/or fume hoods

- If there are no activities that generate air pollutants, you do not need a local exhaust fan or fume hood

☐Y ☐N No major pollutant generating activities

☐Y ☐N Have fume hood and/or exhaust fan

○ **Need fume hood and/or local exhaust fan**

Confirm that fume hoods and local exhaust fans function properly

Check for air flow when fans are on (hold a piece of tissue paper near the fan - or within the space of the fume hood - to see whether it is pulled away from the room).

☐Y ☐N Fume hoods are in good repair; not cracked, broken, or pulling away from the ceiling or wall

☐Y ☐N Fan is operated. (Note if fans are not operated due to noise.)

☐Y ☐N Adjacent rooms or halls odor free.

○ **Need help, hood or exhaust fan does not appear to function properly**

Confirm that fume hoods and fans are used whenever activities that generate pollutants take place

Train students and others who use the classroom or equipment on when and how to use the fume hoods and fans. Conduct pollutant generating activities under the fume hood with exhaust fan turned on. Monitor use throughout the year.

Confirm that fume hoods and fans are used whenever activities that generate pollutants take place

☐Y ☐N Fans and fume hoods are used properly

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ART SUPPLIES

Art supplies may emit contaminants during use and storage. In addition, certain activities (e.g., firing ceramic kilns) may generate air contaminants or heat up the classroom, causing thermal discomfort to occupants.

Although potentially toxic supplies have appropriate labeling since a 1990 federal law took effect, it is still up to teachers to see that safety precautions are followed. Examples of art supplies and activities that may contribute to IAQ problems include: solvents, inks, adhesives, and glues; wax varnishes and lacquers; powdered pigments, acids, clays, paints, and firing kilns.

Learn about your supplies

Check to see whether your supplies (noted above) are listed as toxic or nontoxic. Supplies that are nontoxic will be labeled AP Nontoxic, CP Nontoxic, or Health Label (without warning conditions) by the Art and

Craft Materials Institute or the Center for Safety in the Arts.

Read labels and identify precautions regarding fumes or ventilation. If you make purchase decisions, or recommend products for purchase, confirm that supplies are safe to use.

☐Y ☐N Supplies okay

○ **Need help inventorying supplies, interpreting label warnings, or determining if supplies are safe**

Follow good safety, handling, and storage practices

Have appropriate procedures and supplies available for spill control. Label all hazardous supplies with date of receipt/preparation and pertinent precautionary information. Tightly seal containers. Follow recommended procedures for disposal of used substances. Secure compressed gas cylinders. Supply storage areas should be separate from classroom and ventilated.

☐Y ☐N Following good handling and storage practices

○ **Need help developing good safety, handling, or storage practices**

Minimize exposure to hazardous materials

Substitute less- or non-hazardous materials where possible. Use local exhaust fans. Isolate contaminant producing activities or operations. Use moist-premixed products rather than powdered products. Use techniques that require the least amount of materials.

☐Y ☐N Exposure minimized

○ **Need help minimizing exposure to art supplies**

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SCIENCE SUPPLIES

Some supplies used as teaching aids in science laboratories may contribute to IAQ problems. Science experiments should be conducted in well ventilated rooms using fume hoods and local exhaust systems wherever appropriate. Basic safety precautions can prevent spills or other mishaps that cause air contamination, and should be followed at all times. Examples of science supplies that may contribute to IAQ problems include: solvents, acids, flammables, caustics, biological products, and compressed gases.

Learn about your supplies. Read labels and identify precautions regarding fumes ventilation. Request information and Material Safety Data Sheets (MSDS) from suppliers and manufacturers.

☐Y ☐N Supplies reviewed

☐Y ☐N MSDS on hand

○ **Need help determining impacts of supplies**

Follow good safety, handling, and storage practices

Obtain guidance documents:

- **School Science Laboratories:** *A Guide To Some Hazardous Substances*, 1984 Council of State Science Supervisors and U.S. CPSC, 800-638-2772 (800-492-8104 in MD) U.S. GPO #1984 421-506/3308 *Manual of Safety & Health Hazards In The School Science Laboratory*, 1980 NIOSH/ U.S. Department of Health & Human Services, National Technical Information Service, 703-487-4650, # PB-85-238-228

Have appropriate procedures developed and supplies available for spill control (i.e., absorbent materials to control the spread of spills).

☐Y ☐N Spill procedures in place.

☐Y ☐N All chemicals labeled accurately with date of receipt/ preparation and pertinent precautionary information

☐Y ☐N Supplies stored according to manufacturers' recommendations

☐Y ☐N Recommended procedures for disposal of used substances understood and followed.

☐Y ☐N Compressed gas cylinders secured.

☐Y ☐N Storage areas separate from main classroom area and ventilated separately

○ **Need help with good safety, handling, or storage practices**

Minimize exposure to hazardous materials

☐Y ☐N Diluted substances rather than concentrates used wherever possible

☐Y ☐N Techniques that require the least quantity of hazardous materials used

☐Y ☐N Fume hoods capture respirable particles, gases, and vapors released within them

☐Y ☐N Exhaust fans operate

○ **Need help minimizing exposure to supplies**

Notes ____________________

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INDUSTRIAL AND VOCATIONAL EDUCATION SUPPLIES

Industrial and vocational education materials and operations can create IAQ problems. Examples of the kinds of activities and supplies that may contribute to IAQ problems include: machining, solvents, grinding, fuels, painting, soldering, welding, baking/ heating, and adhesives.

Learn about your supplies

Read labels and identify precautions regarding fumes or ventilation. Request information and Material

Safety Data Sheets (MSDS) from suppliers and manufacturers

☐Y ☐N Supplies reviewed

☐Y ☐N MSDS on hand

○ Need help determining impacts of industrial/vocational supplies

Follow good safety, handling, and storage practices

Develop appropriate procedures and have supplies available for spill control (e.g., absorbent materials to control the spread of spills).

☐Y ☐N Spill procedures in place.

☐Y ☐N Supplies stored according to manufacturers' recommendations

☐Y ☐N Recommended procedures for disposal of used substances understood and followed.

☐Y ☐N Compressed gas cylinders secured.

☐Y ☐N Storage areas separate from main classroom area and ventilated separately

○ Need help with good safety, handling, or storage practices

Minimize exposure to hazardous materials

☐Y ☐N Instructional techniques that require the least quantity of materials used

☐Y ☐N Fume hoods capture respirable particles, gases, and vapors released within them

☐Y ☐N Exhaust fans operate

○ Need help minimizing exposure to supplies

LOCKER ROOM

Locker room conditions that affect indoor air quality include: standing water, high humidity, warm temperatures, and damp or dirty clothing. In addition, some of the methods necessary to control germs and odors in the locker room (e.g., use of disinfectants) may themselves contribute to indoor air quality problems if used improperly (e.g., if sprayed into the air instead of directly onto surfaces).

Verify that showers and other locker room areas are cleaned regularly and properly.

Limit use of chemical cleaners and disinfectants to times when areas are unoccupied. Run exhaust fans to remove moisture and odors.

☐Y ☐N Locker room and showers cleaned regularly and properly

○ Need help to have showers and locker room cleaned regularly and properly.

Maintain cleanliness and reduce excess moisture in the locker room

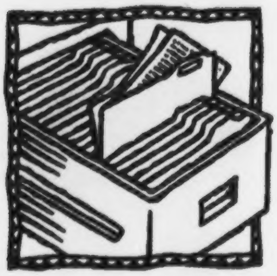
Remove wet towels regularly. Wash and dry soiled practice uniforms regularly. Encourage students to take soiled clothes home regularly. Operate exhaust fans to remove moisture.

☐Y ☐N Soiled clothes and towels are removed regularly

○ Need help to have soiled clothes or towels removed regularly

☐Y ☐N **NO PROBLEMS TO REPORT.** I have completed all activities on this Checklist, and I do not need help in any areas.

Administrative Staff Checklist



This checklist discusses seven major topic areas:

General Cleanliness
Drain Traps
Excess Moisture
Thermal Comfort
Local Exhaust Fans
Ventilation
Printing and Duplicating Equipment

Instructions:

1. Read the *IAQ Backgrounder.*
2. Read each item on this Checklist
3. Check the diamond(s) as appropriate or check the circle if you need additional help with an activity
4. Return this checklist to the IAQ Coordinator and keep a copy for future reference.

Name:

Room or Area:

School:

Date Completed:

Signature:

GENERAL CLEANLINESS

Regular and thorough cleaning is important to ensure good indoor air quality. Unsanitary conditions attract insects and vermin, leading to possible indoor air quality (IAQ) problems from animal or insect allergens or pesticide use. The presence of dirt, moisture, and warmth also stimulates the growth of molds and other microbiological contaminants. While janitors or custodians typically clean administrative offices, you can also play an important role in promoting and maintaining office cleanliness.

Confirm that the office area is cleaned properly

- Make sure that the office is dusted/ vacuumed thoroughly and regularly
- Make sure that trash is removed daily.
- Make sure that food is not kept in offices overnight
- Look for signs of pests

◇ **Office is cleaned thoroughly and properly**

○ **Need help with office cleaning or pest control**

Clean spills promptly

- For spills on carpets involving more than a quart of liquid, contact custodial staff immediately (carpets need to be cleaned, dried, and disinfected within 24 hours)
- Request that unit ventilator filter be replaced if spilled liquid goes into unit (see drawing in *IAQ Backgrounder*)
- Report previous spills on carpets or in unit ventilators because they can affect current indoor air quality

◇ **No significant spills**

○ **Need help with cleaning spill**

DRAIN TRAPS

Drain traps, if present, can become a problem when the water in the drain trap evaporates due to infrequent use, allowing sewer gases to enter the room.

Fill drain traps in your area each week

- Pour water down floor drains (approx. 1 quart of water)
- Run water in sinks (approx. 2 cups of water)
- If not regularly used, flush toilets at least once each week

◇ **Drain traps are filled regularly**

○ **Need help filling drain traps regularly**

EXCESS MOISTURE

Excess moisture contributes to the growth of mold and mildew which causes odors and other IAQ problems. Excess moisture is the result of condensation on cold surfaces, leaking or spilled liquid, or excess humidity.

Check for condensate (condensed water, or "fog") on cold surfaces

- Window glass, frames or sills
- Plumbing (pipes and fixtures)
- Inside surfaces of exterior walls

  ◇ **No condensate**

  ○ **Excess condensate found**

Check for leaks (or signs of wetness) from plumbing or roof

- On ceiling tiles and walls (discolored patches may indicate periodic leaks)
- Around and under sinks
- In lavatories

  ◇ **No leaks or signs of moisture**

  ○ **Found leaks or signs of moisture**

THERMAL COMFORT

Temperature and relative humidity can affect comfort and indoor air quality. Changing thermostat settings or opening windows to try to control temporary fluctuations in temperature can worsen comfort problems and also have an adverse effect on other parts of the school. Comfort for all occupants is a worthy objective, but due to various comfort requirements and clothing levels among occupants, a more practical goal is assuring that at least 80% of the occupants are comfortable.

Check comfort factors

- Temperature (generally 72° F to 76° F)
- Draftiness
- Sunlight shining directly on occupants
- Humidity is too high (typically if higher than 60% relative humidity [R.H.] or too low (typically if lower than 30% R.H.)

  ◇ **Room typically comfortable**

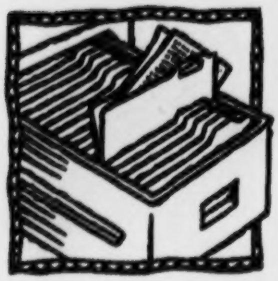
  ○ **Need help, room frequently uncomfortable**

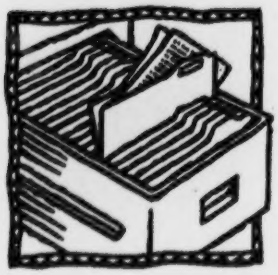
LOCAL EXHAUST FANS

Local exhaust fans can be used to prevent air pollutants from accumulating in, or spreading beyond, the local area or room where pollutants are generated. A local exhaust fan can be linked to the operation of a particular piece of equipment (such as a duplicator) or used to treat an entire room (such as a smoking room or custodial closet).

Determine if activities generate air pollutants and whether the room or area is equipped with local exhaust fans

- Typical office activities that generate air pollutants include: smoking, operation of some office equipment and food preparation and eating
- If there are no activities that generate air pollutants, then you do not need a local exhaust fan





- Local exhaust fans should be considered for the school nurse's office to help prevent the spread of germs throughout the school

◇ **No major pollutant generating activities**

◇ **Have local exhaust fan(s)**

○ **Need local exhaust fan(s)**

Confirm that local exhaust fans (if any) function properly

- Check for air flowing in the proper direction when fans are switched on (use chemical smoke obtained from the IAQ coordinator, or pieces of tissue)
- Odorous pollutants seem to be properly removed
- Fan is too noisy to use

◇ **Local exhaust fans function**

○ **Need help evaluating or fixing fan(s)**

Confirm that fans are used whenever activities that generate air pollutants take place

- Conduct pollutant generating activities only when the exhaust fan(s) is on

◇ **Fans are used properly**

○ **Fans are not used properly**

VENTILATION

Ventilation is the process by which stale indoor air is exhausted to the outside and outside air is drawn into the building. Your building may have mechanical and/or natural ventilation (i.e., windows). Improperly operated or poorly maintained ventilation systems may cause IAQ problems. Odors may indicate a ventilation problem. The ventilation system can carry air pollutants from another location in the school to your area.

Determine how your office is ventilated

- Locate unit ventilators (if any)
- Locate air supply and return vents (if any)
- Determine whether your windows (if any) are operable

◇ **Located the unit ventilator**

◇ **Located air supply and return vents**

◇ **Windows are operable**

○ **Need help determining type of ventilation**

If you have mechanical ventilation, confirm that air is flowing into the room from the air supply vent(s)

- Check for airflow by holding a tissue or strip of lightweight plastic near the air supply vent(s); if air is flowing, the plastic or tissue will flutter away from the supply vent
- Make sure that the airflow is not diverted or obstructed by books, papers, furniture, curtains, or other obstacles. Never place anything on top of unit ventilators

✱ **No problem, air is flowing without obstruction**

○ **No supply air or need help removing obstruction**

If you have mechanical ventilation, confirm that air is flowing from the room into the air return grilles

- Check for airflow at air return grilles in the same manner as the previous activity. If air is flowing, the plastic or tissue will be pulled toward the air return grilles. Alternatively, a piece of plastic or tissue that nearly covers the grille will stick to the face of the grilles if air is flowing
- Make sure that the airflow is not diverted or obstructed by books, papers, furniture, curtains, etc.

◇ **No problem, air is flowing without obstruction**

○ **No exhaust air or need help removing obstruction**

Check for unexplained odors

- Vehicle exhaust
- Kitchen/food
- "Chemical" smell
- Mold or mildew

◇ **No problem, never detect any odors**

○ **Need help, sometimes smell odors**

PRINTING/DUPLICATING EQUIPMENT

Printing and duplicating equipment can generate indoor air pollutants. Common types of duplicating and printing equipment include: photocopiers, spirit duplicating machines, mimeograph machines, diazo dyeline (blueprint) machines, electronic stencil makers and computer (laser) printers. Spirit duplicating machines and diazo dyeline (blueprint) machines present particular IAQ problems due to the presence of methyl alcohol and ammonia, respectively. Local exhaust and ventilation is important (see the previous activities).

Confirm that the equipment functions properly

- Equipment does not leak
- No odors detected
- Equipment is regularly maintained
- No complaints from individuals who are exposed to the equipment

◇ **Equipment functions properly**

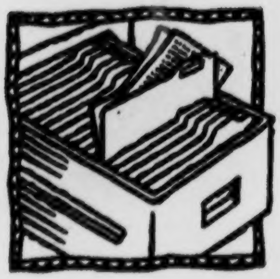
○ **Need help determining whether equipment functions properly**

Minimize staff and student exposure to equipment

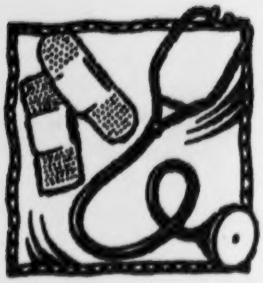
- Equipment is located in a well ventilated area with sufficient outdoor air
- Spirit duplicating equipment and diazo dyeline copiers should be located in separate room with a fan to exhaust air to the outside

◇ **Equipment is located in well ventilated area or separate room with appropriate local exhaust**

○ **Need help moving equipment or minimizing exposure**



☐ **NO PROBLEMS TO REPORT.** I have completed all activities on this Checklist, and I do not need help in any areas.



Health Officer/School Nurse

This checklist discusses three major topic areas:

Student Health Records Maintenance

Public Health and Personal Hygiene Education

Health Officer's Office

Instructions:

1. Read the *IAQ Backgrounder.*
2. Read each item on this Checklist.
3. Check the diamond(s) as appropriate or check the circle if you need additional help with an activity.
4. Return this checklist to the IAQ Coordinator and keep a copy for future reference.

Name:

Room or Area:

School:

Date Completed:

Signature:

MAINTAIN STUDENT HEALTH RECORDS

There is evidence to suggest that children, pregnant women, and senior citizens are more likely to develop health problems from poor air quality than most adults. Indoor Air Quality (IAQ) problems are most likely to affect those with preexisting health conditions and those who are exposed to tobacco smoke. Student health records should include information about known allergies and other medically documented conditions, such as asthma, as well as any reported sensitivity to chemicals. Privacy considerations may limit the student health information that can be disclosed, but to the extent possible, information about students' potential sensitivity to IAQ problems should be provided to teachers. This is especially true for classes involving potential irritants (e.g., gaseous or particle emissions from art, science, industrial/vocational education sources). Health records and records of health-related complaints by students and staff are useful for evaluating potential IAQ-related complaints.

Include information about sensitivities to IAQ problems in student health records

- Allergies, including reports of chemical sensitivities
- Asthma

◇ Completed health records exist for each student

◇ Health records are being updated

○ Need help obtaining information about student allergies and other health factors

Track health-related complaints by students and staff

- Keep a log of health complaints that notes the symptoms, location and time of symptom onset, and exposure to pollutant sources
- Watch for trends in health complaints, especially in timing or location of complaints

◇ Have a comprehensive health complaint logging system.

◇ Developing a comprehensive health complaint logging system

○ Need help developing a comprehensive health complaint logging system

Recognize indicators that health problems may be IAQ-related

- Complaints are associated with particular times of the day or week
- Other occupants in the same area experience similar problems
- The problem abates or ceases, either immediately or gradually, when an occupant leaves the building and recurs when the occupant returns

- The school has recently been renovated or refurnished
- The occupant has recently started working with new or different materials or equipment
- New cleaning or pesticide products or practices have been introduced into the school
- Smoking is allowed in the school
- A new warm-blooded animal has been introduced into the classroom

◇ Understand indicators of IAQ-related problems

○ Need help understanding indicators of IAQ-related problems

HEALTH AND HYGIENE EDUCATION

Schools are unique buildings from a public health perspective because they accommodate more people within a smaller area than most buildings. This proximity increases the potential for airborne contaminants (germs, odors, and constituents of personal products) to pass between students. Raising awareness about the effects of personal habits on the well-being of others can help reduce IAQ-related problems.

Obtain *Indoor Air Quality: An Introduction for Health Professionals*

- Contact IAQ INFO, 800-438-4318

◇ Already have this EPA guidance document

◇ Guide is on order

○ Cannot obtain the guide

Inform students and staff about the importance of good hygiene in preventing the spread of airborne contagious diseases

- Provide written materials to students (local public health agencies may have information suitable for older students)
- Provide individual instruction/ counseling where necessary

◇ Written materials and counseling available

◇ Compiling information for counseling and distribution

○ Need help compiling information or implementing counseling program

Provide information about IAQ and health

- Help teachers develop activities that reduce exposure to indoor air pollutants for students with IAQ sensitivities, such as those with asthma or allergies (contact the American Lung Association [ALA] the National Association of School Nurses [NASN] or the Asthma and Allergy Foundation of America [AAFA]). Contact information is available in the IAQ Coordinator's Guide.
- Collaborate with parent-teacher groups to offer family IAQ education programs
- Conduct a workshop for teachers on health issues that covers IAQ

◇ Have provided information to parents and staff

◇ Developing information and education programs for parents and staff

○ Need help developing information and education program for parents and staff

Establish an information and counseling program regarding smoking

- Provide free literature on smoking and secondhand smoke
- Sponsor a quit-smoking program and similar counseling programs in collaboration with the ALA

◇ "No Smoking" information and programs in place

◇ "No Smoking" information and programs in planning

○ Need help with a "No Smoking" program

HEALTH OFFICER'S OFFICE

Since the health office may be frequented by sick students and staff, it is important to take steps that can help prevent transmission of airborne diseases to uninfected students and staff (see your IAQ Coordinator for help with the following activities).

Ensure that the ventilation system is properly operating

- Ventilation system is operated when the area(s) is occupied
- Provide an adequate amount of outdoor air to the area(s). There should be at least 15 cubic feet of outdoor air supplied per occupant
- Air filters are clean and properly installed
- Air removed from the area(s) does not circulate through the ventilation system into other occupied areas

◇ Ventilation system operating adequately

○ Need help with ventilation related activities

☐ **NO PROBLEMS TO REPORT.** I have completed all activities on this Checklist, and I do not need help in any areas.

Ventilation Checklist & Log

Schools use a variety of methods for ventilating the building with outdoor air: 1) mechanically-based systems such as unit ventilators, central HVAC systems, and central exhaust systems, and; 2) passive systems that rely on operable windows, air leaks, wind, and the stack effect (the tendency of warm air to rise).

The majority of the Ventilation Checklist/Log activities apply mainly to mechanical ventilation systems, and are designed to accomplish two functions:

- Ensure that the ventilation system is clean, and
- Ensure that an adequate amount of outdoor air is supplied to occupied areas.

Many of these activities should be performed by individuals with appropriate training in mechanical systems and safety procedures. Most activities can be performed with basic maintenance tools, but Activity 22 will require airflow measurement equipment that you may not have. The section *How to Measure Airflow*, at the back of this Checklist, describes the type of equipment used to measure airflow. The IAQ Coordinator has information on how this equipment can be obtained (**Appendix C** of the Coordinator's Guide). Make an effort to obtain this equipment before conducting Activity 17. Supplying an adequate amount of outdoor air to an occupied area is necessary for good indoor air quality, and measuring airflow can only be done correctly with equipment that can reliably tell you if you're getting the proper amount of outdoor air (visual inspection or feeling for air movement is not sufficient).

Activities 17-21 can be applied to passive ventilation systems. For activities that do not apply, place a "NA" in the date column of the Ventilation Log.

Your school most likely has multiple units and systems, so be sure to perform the activities and complete the Ventilation Log for each unit. The activities are listed in a purposeful order to prevent having to repeat activities for a given unit as the inspection progresses. The following is a recommended process for saving time in performing the activities:

Activities 1-3

Perform these activities for all outdoor air intakes while outside the building, and mark the results on the Ventilation Log for each unit.

Activities 4-12

Perform these activities as a set on each ventilation unit while you're in the room and the unit is open.

Activities 13-16

Perform these ventilation control system activities as required by your situation.

Activities 17-21

Perform these air distribution and exhaust system activities as required by your situation.

This checklist discusses eight major topic areas:

Outdoor Air Intakes

System Cleanliness

Controls for Outdoor Air Supply

Air Distribution

Exhaust Systems

Quantity of Outdoor Air

Adequacy of Outdoor Air Supply

How to Measure Air Flow

Instructions:

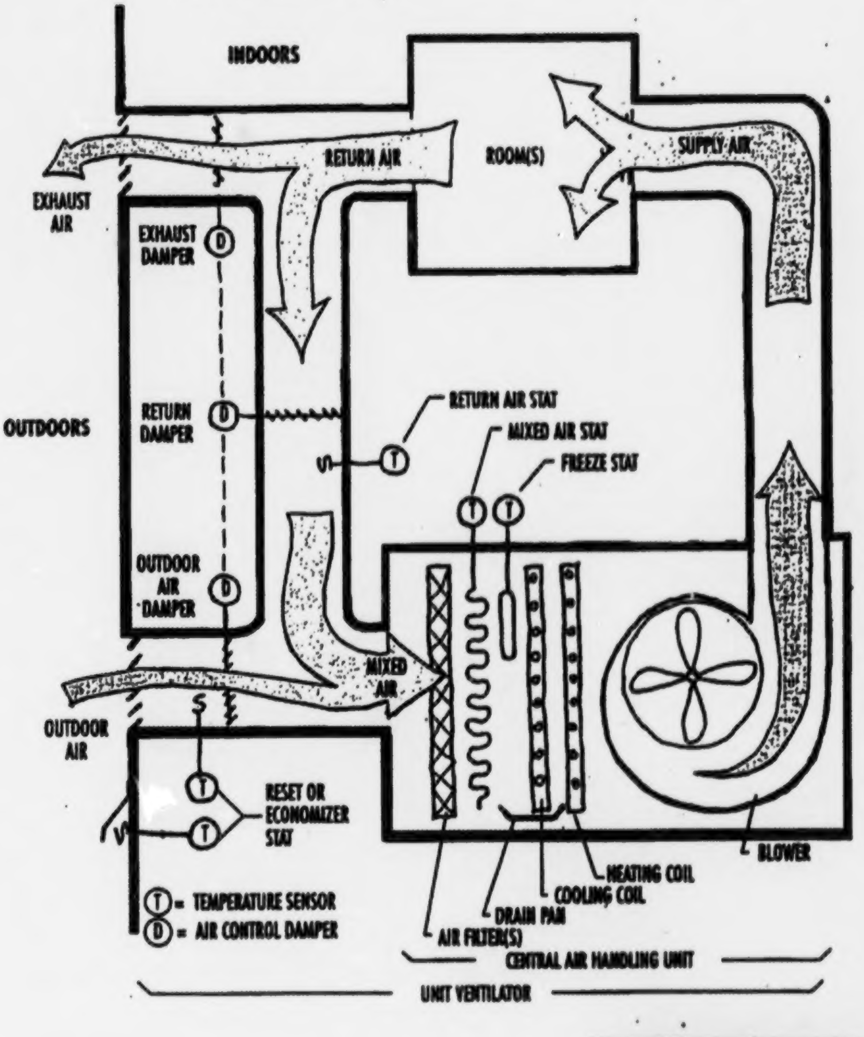
1. Read the *IAQ Backgrounder.*
2. **Important!** Read the Ventilation Activity explanations accompanying this checklist (pages 5-13).
3. Make one copy of the Ventilation Log (pages 3-4) for **each** ventilation unit in your school.
4. Complete each activity for **each** ventilation unit and note the status of each activity on the Ventilation Log.
5. Return the Ventilation Logs to the IAQ Coordinator and keep copies for future reference.

Activities 22-23

Perform these activities regarding the quantity of outdoor air on all units while you have the airflow measurement equipment available.

All of these activities are described in the information following the Log. For more detailed information see *Building Air Quality: A Guide for Building Owners and Facility Managers* (EPA-400-1-91-033) listed in Appendix I of the *IAQ Coordinator's Guide.*

Typical HVAC System


INDOORS
RETURN AIR
ROOM(S)
SUPPLY AIR
EXHAUST AIR
EXHAUST DAMPER
D
RETURN DAMPER
OUTDOORS
RETURN AIR STAT
MIXED AIR STAT
FREEZE STAT
OUTDOOR AIR DAMPER
MIXED AIR
OUTDOOR AIR
RESET OR ECONOMIZER STAT
T = TEMPERATURE SENSOR
D = AIR CONTROL DAMPER
HEATING COIL
COOLING COIL
DRAIN PAN
AIR FILTER(S)
BLOWER
CENTRAL AIR HANDLING UNIT
UNIT VENTILATOR

Name

School

Room or Area

Ventilation Log

Instructions:

- ☐ Make one copy of this Checklist and Log for **each** ventilation unit in your school.
- ☐ Perform the activities on the Checklist and Log for **each** ventilation unit and record your results.
- ☐ One column is provided for each inspection. Put the date at the top of the column, and initial each response. For subsequent inspections on the same unit, move to the next column until the sheet is full.
- ☐ A "No" response requires further attention.

ACTIVITY	NEEDS ATTENTION IF "NO"	DATE: INITIALS	NEEDS ATTENTION IF "NO"	DATE: INITIALS	NEEDS ATTENTION IF "NO"	DATE: INITIALS
Outdoor Air Intakes (see page 5 for more information)						
1. Outdoor air intakes not obstructed	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
2. Outdoor air intake clear of nearby pollutant sources	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
3. Outdoor air moving into intake	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
System Cleanliness (see page 6 for more information)						
4. Filters in good condition, properly installed, and no major air leaks	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
5. Drain pan clean and no standing water	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
6. Heating and cooling coil(s) clean	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
7. Interior of air handling unit and ductwork clean	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
8. Mechanical room free of trash and chemicals	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
Controls for Outdoor Air Supply (see pages 7-9 for more information)						
9. Controls information on hand	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
10. Clocks, timers, and switches properly set	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
11. Pneumatic controls okay	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
12 Outdoor air damper operating properly	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	

ACTIVITY	NEEDS ATTENTION IF "NO"	DATE: INITIALS	NEEDS ATTENTION IF "NO"	DATE: INITIALS	NEEDS ATTENTION IF "NO"	DATE: INITIALS
Controls for Outdoor Air Supply (continued)						
13. Freeze-stat reset	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
14. Mixed air thermostat set properly	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
15. Economizer set per specifications	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
16. Fans supplying outdoor air operate continuously during occupied periods	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
Air Distribution (see pages 9-10 for more information)						
17. Air distribution function per design	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
18. Air flow direction (relative pressures) okay	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
Exhaust Systems (see page 10-11 for more information)						
19. Exhaust fans operating	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
20. Local exhaust fan(s) remove enough air to eliminate odors and chemical fumes	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
21. Exhaust ductwork sealed and in good condition	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	
Quantity and Adequacy of Outdoor Air Supply (see page 11-12 for more information)						
22. Measure quantity of outdoor air a. outdoor air supply b. number of occupants served by this unit c. CFM/occupants (a ÷ b) Meets original design specs?	___ ___ ___		___ ___ ___		___ ___ ___	
23. Recommendation in Table 1 for this type of area: ______	☐ Yes ☐ No		☐ Yes ☐ No		☐ Yes ☐ No	

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Explanatory Information for Ventilation Log Items

OUTDOOR AIR INTAKES

If outdoor air intakes are deliberately blocked or become clogged with dirt or debris, areas they serve are likely to get insufficient outdoor air. Students or staff might experience stuffy or stagnant air, or develop health problems from exposure to accumulated pollutants.

☐ On a small floor plan (e.g., a fire escape floor plan), mark the locations of outdoor air intakes, based on mechanical plans (if available) and your observations while performing these activities.

☐ Obtain chemical smoke (or, alternatively, a small piece of tissue paper or light plastic) before performing Activity 3. For more information on chemical smoke, see *How to Measure Airflow*, at the end of this Checklist.

☐ Ensure that the ventilation system is on and operating in "occupied" mode

1. Ensure that outdoor air intakes are unobstructed

☐ Check the intakes from outside the school building for obstructions, such as debris, clogged screens, or make-shift covers (e.g., boards or plastic)

☐ Remove any obstructions

☐ Install corrective devices if snowdrifts or leaves often block an intake

2. Ensure that outdoor air intakes are clear of nearby pollutant sources

☐ Check the intakes from outside the school building to confirm that pollutant sources are not located near outdoor air intakes

- At ground level, look for dumpsters, loading docks, and bus-idling areas
- At roof level, look for plumbing vents, exhaust outlets (such as kitchen, toilet, or laboratory exhaust fans), puddles on the roof, and mist from air-conditioning cooling towers

☐ Resolve problems due to pollutants near intakes

- Remove sources, where possible (for example, move a dumpster to another location)
- Separate the source from the intake (for example, add another pipe section to raise a nearby exhaust outlet above the intake)
- Change operating procedures (for example, turn off vehicles instead of idling at loading docks and bus stands)

3. Confirm that outdoor air is entering the system intake

☐ Use chemical smoke (or, alternatively, a small piece of tissue paper or light plastic) to show whether air is moving into the intake grille

SYSTEM CLEANLINESS

Accumulated dirt can interfere with the proper operation of the ventilation system and lead to underventilation, uncomfortable temperatures, less efficient operation (higher utility bills), more maintenance, and decreased life expectancy of equipment. Air filters are intended primarily to prevent dirt and dust from accumulating in the HVAC system. If filters are not properly selected and maintained, built-up dirt in coils and ducts could provide a habitat for microbiological growth. Filters that are clogged with dirt restrict the flow of air through the HVAC system. If filters "blow out" and allow the passage of unfiltered air, dirt can accumulate on coils (producing a need for more frequent cleaning) and reduce the efficiency of the heating and/or cooling plant. It is much less expensive to trap dirt with properly maintained filters than to remove it from ductwork, coils, fan blades, and other HVAC system components.

WARNING: Do not clean dirty or biologically contaminated system components when the system is operating and the building is occupied.

WARNING: If there is visible biological growth, such as mold, minimize your exposure to air in the interior of ducts or other HVAC equipment. Use proper respiratory protection; obtain expert advice about the kind of respiratory protection to use and how to use it.

4. Inspect air filters on ventilation equipment

☐ Install new filters as needed. Shut off ventilation system fans when replacing associated filters so that dirt will not blow downstream. Vacuum the filter area before installing the new filter

☐ Confirm that filters fit properly in their tracks, with no major air leaks that would allow air to bypass (flow around) the air filter

☐ Confirm that filters are installed in the proper direction for airflow

5. Ensure that condensate drain pans are clean and drain properly

● Drain pans should slant toward the drain so they do not collect and hold water

6. Ensure that heating and cooling coils are clean

7. Ensure that air handling unit(s) (air mixing chambers, coils, and fan blades) and duct interiors are clean

8. Ensure that the mechanical rooms are free of trash and chemicals

☐ Check mechanical room for unsanitary conditions, leaks, or spills

☐ Confirm that mechanical rooms and air mixing chambers are not used to store trash or chemical products and supplies

[redacted]

CONTROLS FOR OUTDOOR AIR SUPPLY

This group of activities is for ventilation systems that use fans or blowers to supply outdoor air to one or more rooms within a school. The primary objectives that you should keep in mind as you perform these activities are:

- Ensure that air dampers are always at least partially open (minimum position) during occupied hours, and
- Ensure that the minimum position provides an adequate amount of outdoor air for the occupants.

These activities are fairly generic, and apply to most ventilation systems. See the figures in the *IAQ Backgrounder* for more information.

Activities 9-11 generally serve multiple ventilation units, while activities 12-16 are related and performed at each individual ventilation unit. Based on your equipment and experience, perform as many of the activities and make as many indicated repairs as possible. Discuss the need for additional help for any uncompleted activities or repairs with your IAQ Coordinator.

9. Gather controls information

Your ventilation controls may be uniquely designed, and since there are many different types and brands of control components, it can be very helpful if you:

- Gather and read any controls specifications, as-built mechanical drawings, and controls operations manuals that you may have
- Contact the system installer or HVAC maintenance contractor to obtain controls information that is missing from your files

10. Check Clocks, Timers, and Seasonal Switches

☐ Confirm that summer-winter switches are in the right position

☐ Confirm that time clocks read the correct time

☐ Confirm that time clock settings fit the actual schedule of building use (night/weekend set-back and set-up)

11. Check pneumatic control system components (if any)

☐ Test the line pressure at both the occupied (day) setting and the unoccupied (night) setting to determine whether the overall system pressure is appropriate

☐ Confirm that the line dryer is preventing moisture buildup

☐ Check the control system filters. The filter at the compressor inlet should be changed periodically in keeping with the compressor manufacturer's recommendation (for example, when you blow down the tank)

☐ Ensure that the line pressure at each thermostat and damper actuator is at the proper level (no leakage or obstructions)

☐ Repair or replace defective components

12. Check outdoor air damper operation

Before continuing, the air temperature in the indoor area(s) served by this outdoor air damper must be within the normal operating range, and ensure that the outdoor air damper is visible for your inspection

☐ Turn off the air handler connected to the outdoor air damper and confirm that the damper fully closes within a few minutes

☐ Turn on the air handler and confirm that the outdoor air damper opens at least partially with little or no delay

☐ Set the room thermostat as follows, and observe the damper for movement (damper should go to its minimum position, but not completely closed):

- If in heating mode, set the room thermostat to 85°F
- If in cooling mode, set the room thermostat to 60°F, mark the current setting of the mixed air thermostat, and set it to a low setting (about 45°F)

If the outdoor air damper does not move:

- Confirm that the damper actuator is linked to the damper shaft and that any linkage set screws or bolts are tight
- Confirm that rust or corrosion are not preventing free movement
- Confirm that either electrical wires or pneumatic tubing is connected to the damper actuator
- Reset thermostat(s) to appropriate temperature(s)

Proceed to Activities 13-16 if the damper seems properly operating

> *NOTE: The minimum damper setting, adjusted with a nut or a knob, may have to be adjusted to allow a larger damper opening if the amount of outdoor air supply measured in Activity 22 is not adequate for the number of occupants being served.*

Unit Ventilators are sometimes specified to operate under one of the following ASHRAE sequences:

Cycle I: Except during warm-up stage (outdoor air damper closed), Cycle I supplies 100% outdoor air at all times.

Cycle II: During the heating stage, Cycle II supplies a set minimum quantity of outdoor air. Outdoor air is gradually increased, as required for cooling. During warm-up, the outdoor air damper is closed. (Typical sequence for northern climates.)

Cycle III: During the heating, ventilating and cooling stages, Cycle III supplies a variable amount of outdoor air as required to maintain a fixed temperature (typically 55°F) entering the heating coil. When heat is not required, this air is used for cooling. During warmup, the outdoor air damper is closed. (Typical sequence for southern climates, with adaptions for mechanical cooling.)

The following four items may be responsible for keeping outdoor air dampers closed during the normal occupied cycle.

13. Confirm freeze-stat condition

HVAC systems with water coils need protection from freezing. The freeze-stat may close the outdoor air damper and disconnect the supply air when tripped. The typical trip range is 35°F to 42°F.

- If the freeze-stat has a manual reset button (usually red), depress the button. If a click is heard, the freeze-stat was probably tripped. Consider replacing manual reset freeze-stats with automatic reset freeze-stats
- If the freeze-stat has an automatic reset, disconnect power to the controls and test for continuity across the terminals

14. Check mixed air thermostat

- The mixed air stat for heating mode should be set no higher than 65°F
- The mixed air stat for cooling mode should be set no lower than the room thermostat setting

15. Check air economizer setting

Economizers use varying amounts of cool outdoor air to assist with the cooling load of the room or rooms. There are two types of economizers, dry-bulb and enthalpy. Dry-bulb economizers vary the amount of outdoor air based on outdoor air temperature, and enthalpy economizers vary the amount of outdoor air based on outdoor air temperature and humidity level.

☐ Confirm proper settings based on design specifications or local practices (dry-bulb setting typically 65°F or lower)

☐ Check the sensor to make sure that it is shielded from direct sunlight

16. Confirm that fans operate continuously during occupied periods

- Any fan that helps move air from outdoors to indoors must operate continuously during occupied hours, even though the room thermostat is satisfied.
- If the fan shuts off when the thermostat is satisfied, change the control cycle to prevent underventilation.

AIR DISTRIBUTION

Even if enough outdoor air is brought into a school building, IAQ problems can develop if the outdoor air is not properly distributed. In such cases, underventilation occurs in particular areas of the building rather than being widespread. Problems with air distribution are most likely to occur in areas where:

- Ventilation equipment is malfunctioning
- Room layouts have been altered without adjusting the HVAC system
- The population of a room or zone has grown without adjustment to the HVAC system
- Air pressure differences move air contaminants from outdoors to indoors and transport them within buildings.

In schools with mechanical ventilation equipment, fans are the dominant influence on pressure differences and air flows. In schools without mechanical ventilation equipment, natural forces (wind and stack effect) primarily influence airflows.

To prevent infiltration of outdoor air and soil gas (e.g., radon), mechanically-ventilated buildings are often designed to maintain a higher air pressure indoors than outdoors, which is known as positive pressurization (See "Exhaust Systems" and "How to Measure Airflow" for a description of building pressurization). At the same time, exhaust fans control indoor contaminants by keeping rooms such as smoking lounges, bathrooms, kitchens, and laboratories under negative pressure compared to surrounding rooms. "Negative pressure" and "positive pressure" describe pressure relationships. A room can operate under negative pressure as compared to neighboring rooms, but at the same time it may be positive compared to outdoors.

17. Check air distribution

Verify that air pathways in the original ventilation system design continue to function.

☐ Check to see whether operable windows have been replaced by windows that cannot be opened

☐ Check to see whether passive gravity relief ventilation systems and transfer grilles between rooms and corridors are functioning. If they are closed off or blocked to meet modern fire codes, consult with a professional engineer for remedies

☐ Verify that every occupied space has a supply of outdoor air (mechanical system or operable windows)

☐ Confirm that supplies and returns are open and unblocked. If outlets have been blocked intentionally to correct drafts or discomfort, investigate and correct the cause of the discomfort and reopen the vents

☐ If you discovered areas with no source of outside air, modify the HVAC system to correct the problem

☐ Check for barriers, such as room dividers, large free-standing blackboards or displays, or bookshelves, that could block movement of air in the room, especially if they block air vents

18. Check air flow direction

☐ Confirm that the system, including any exhaust fans, is operating on the occupied cycle when doing this activity.

● Where outdoor contaminant sources have been identified, use chemical smoke to determine whether the air flows out of the building through leaks in nearby windows, doors, or other cracks and holes in exterior walls

● Use chemical smoke to determine whether air flows out of the building through below-grade cracks and holes (e.g., floor joints, pipe openings)

EXHAUST SYSTEMS

Exhaust systems are used to remove air that contains contaminants, including odors. Some HVAC designs also rely on the operation of exhaust fans to create negative pressure that draws outdoor air into the building through windows and gaps in the building envelope.

19. Confirm that exhaust fans are operating

● Use chemical smoke to confirm that air is flowing into the exhaust grille(s)

[redacted]

20. Verify that local exhaust fans remove enough air to eliminate odors and chemical fumes

If the fan is intended to exhaust the entire room, stand outside the room with the door slightly open and use chemical smoke to confirm that air is being drawn into the room from locations both high and low in the door opening (see *How to Measure Airflow*).

If the fan is running, but air isn't flowing toward the exhaust intake (or too little air is moving to do the job), check for the following possibilities:

- The backdraft damper at the exhaust outlet does not open
- Obstructions in the ductwork
- Leaky or disconnected ductwork
- Broken fan belt
- Motor running backwards
- Design problems (e.g., undersized fan)

21. If the exhaust fan is located close to the contaminant source, rather than on the roof, and exhaust air is ducted through the building under positive pressure

- Confirm that the exhaust ductwork is sealed and in good condition.

QUANTITY OF OUTDOOR AIR

22. Measure quantity of outdoor air per person

See *How to Measure Airflow* at the end of this Checklist for techniques on measuring outdoor air supply.

Measure the quantity of outdoor air supplied either to or from each ventilation unit. Use the Ventilation Log to calculate the quantity of outside air per person being provided to occupants (22a. on the Ventilation Log)

Count or calculate the number of occupants served by the ventilation unit under consideration (22b. on the Ventilation Log)

Divide the quantity of outdoor air supplied by the number of occupants served for the ventilation unit under consideration (22a divided by 22b on the Ventilation Log)

ADEQUACY OF OUTDOOR AIR SUPPLY

23. Compare the measured outdoor air per person to Table 1

In the first column of Table 1, find the listing for the type of area that is served by the unit you are evaluating

Check the second column to see if the occupancy for each 1,000 square feet that the ventilation unit serves is no greater than the occupancy assumed for the recommendations

Compare the recommended ventilation in the third column of Table 1 to the calculated outdoor air per person from Activity 22.

[redacted]

If the calculated airflow is below the recommendations in Table 1, it may be that the school was designed to meet a lower standard that was in effect at the time the school was built. If you have design specifications for the system or know code requirements in effect at the time of construction, compare the measured outdoor air to this specification. Repair the system to meet the design specification, if necessary.

If the school was designed to a lower standard and cannot meet the recommended levels in Table 1, discuss with the IAQ Coordinator means for increasing ventilation:

- Retrofitting the ventilation system for increased capacity
- Opening windows (Caution: Consider potential ventilation problems that this may cause in other parts of the building)
- Make any repairs permanent and take any other measures that appear to help ensure adequate outdoor air in the future. These improvements will probably require the services of a professional engineer.

Table 1: Selected ASHRAE Ventilation Recommendations

Type of Area	Occupancy (people/1000 ft^2)	CFM/person
Instructional Areas		
Classrooms	50	15
Laboratories	30	20
Music rooms	50	15
Training shops	30	20
Staff Areas		
Conference rooms	50	20
Offices	70	20
Smoking lounges	7	60
Bus garage: 1.5 CFM per square foot of floor area. Distribution among people must consider worker location and concentration of running engines; stands where engines are run must incorporate systems for positive engine exhaust withdrawal. Contaminant sensors may be used to control ventilation.		
Assembly Rooms		
Auditoriums	150	15
Libraries	20	20
Gymnasiums		
Spectator areas	150	15
Playing floor	30	20
Food and Beverage Service		
Cafeteria	100	20
Kitchen	20	15
Additional airflow may be needed to provide make-up air for hood exhaust(s). The sum of the outdoor air and transfer air of acceptable quantity from adjacent spaces shall be sufficient to provide an exhaust rate of not less than 1.5 CFM/square foot.		
Miscellaneous		
Nurse's offices (patient areas)	10	25
Corridors:	0.1 CFM/square foot	
Locker rooms:	0.5 CFM/square foot	
Restroom: 50 CFM/urinal or water closet		

SOURCE: ASHRAE Standard 62-1989, Ventilation for Acceptable Air Quality

HOW TO MEASURE AIRFLOW

This section provides basic guidance and options for determining air movement and measuring outdoor air supply. It is divided into three sections:

- Using chemical smoke to determine air flow direction
- Measuring airflow to determine outdoor air supply quantity
- Estimating outdoor air quantity using carbon dioxide measurements

1. Using Chemical Smoke to Determine Air Flow Direction

Chemical smoke can be helpful in evaluating HVAC systems, tracking air and pollutant movement, and identifying pressure differentials. Chemical smoke moves from areas of higher pressure to areas of lower pressure if there is an opening between them (e.g., door, utility penetration).

Because it is the same temperature as the surrounding air, chemical smoke is extremely sensitive to air currents. Investigators can learn about airflow patterns by observing the direction and speed of smoke movement. Smoke released near outdoor air intakes will indicate whether air is being drawn into the intake. Puffs of smoke released at the shell of the building (by doors, windows, or gaps) will indicate whether the HVAC systems are maintaining interior spaces under positive pressure relative to the outdoors.

Chemical smoke is available with various dispensing mechanisms, including smoke "bottles," "guns," "pencils," or "tubes." The dispensers allow smoke to be released in controlled quantities and directed at specific locations. It is often more informative to use a number of small puffs of smoke as you move along an air pathway rather than releasing a large amount in a single puff.

Caution: Chemical smoke devices use titanium tetrachloride to produce smoke. While the chemicals forming the smoke normally are not hazardous in the small quantities produced during testing, avoid inhaling smoke from smoke devices. Concentrated fumes from smoke devices are very corrosive.

Determining Air Movement From Diffusers And Grilles

Puffs of smoke released near HVAC vents give a general idea of airflow. (Is it in or out? Vigorous? Sluggish? No flow?) This is helpful in evaluating the supply and return system and determining whether ventilation air actually reaches the breathing zone. (For a variable air volume system, be sure to take into account how the system is designed to modulate. It could be on during the test, but off for much of the rest of the day.) "Short-circuiting" occurs when air moves directly from supply diffusers to return grilles, instead of mixing with room air in the breathing zone. If a substantial amount of air short-circuits, occupants may not receive adequate supplies of outdoor air and source emissions may not be diluted sufficiently.

2. Measuring Outdoor Air Supply Quantity

This section describes methods for determining the amount of outdoor air being supplied by a single ventilation unit using either a Flow Hood or air velocity measurement device. These are general instructions for measuring airflow. Follow the instructions provided by the manufacturer of your measuring equipment.

Step 1. Determine Airflow Quantity

Using a Flow Hood

Flow Hoods measure airflow in cubic feet per minute (CFM) at a diffuser or grille. Taking the measurement is simply a matter of holding the hood up to the diffuser and reading the airflow value. Follow the instructions supplied with the Flow Hood regarding use, care, and calibration.

Using Velocity Measurements

For information on measuring air velocity using a Pitot tube or anemometer and calculating outdoor air supply, see the instructions supplied with the equipment.

Airflow in large ductwork can be estimated by measuring air velocity using a Pitot tube with a differential pressure gauge or an anemometer. (See the IAQ Coordinator for sources of these devices.)

- Measure the air velocity in the ductwork and calculate the outdoor airflow in cubic feet per minute (CFM) at the outdoor air intake of the air handling unit or other convenient location
- Enter the calculated outdoor air supply in the Ventilation Log

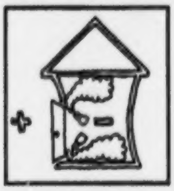
For Systems Without Mechanically-Supplied Outdoor Air

If your system does not have mechanically supplied outdoor air, you can estimate the amount of outdoor air infiltrating the area. Estimate air infiltration by measuring the quantity of air exhausted by exhaust fans serving the area.

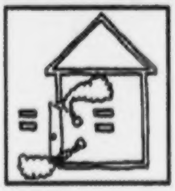
- Using a small floor plan, such as a fire escape map, mark the areas served by each exhaust fan
- Measure airflow at grilles or exhaust outlets using a flow hood. Determine the airflow in ductwork by using a Pitot tube with a differential pressure gauge or an anemometer
- Add the airflows (in CFM) from all exhaust fans serving the area you are measuring and enter the measurement in the Ventilation Log

> A room can be positively or negatively pressurized when compared to the spaces surrounding it. These spaces include another room, a corridor, or outdoors. To determine whether a room is positively or negatively pressurized, or neutral, release puffs of smoke near the top and bottom of a slightly opened door or window, and observe the direction of flow. Example: If the smoke flows inward at both the top and bottom of a slightly opened door, the room is negatively pressurized when compared to the space on the other side of the door.
>
> Negative pressurization may cause problems with natural draft combustion appliances, or cause outdoor pollutants such as pollens or vehicle exhaust in loading docks to be drawn into the building through openings.

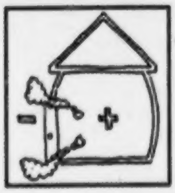
Negative Pressure



Neutral Pressure



Positive Pressure



Step 2. Determine Occupancy

Count the number of students and staff located in areas served by the air handling unit (called the occupied zone). If you are estimating infiltration using exhaust fan airflows, count individuals in the area you have determined are affected by the fan(s) in Step 1.

- Using a small floor plan, mark the occupied zone served by the unit. In areas served by unit ventilators, an occupied zone is probably an individual classroom. In areas served by large air handling units, an occupied zone may include several rooms. A large gymnasium or other room may be served by several air handling units.

- Estimate the number of occupants in the occupied zone, including students, teachers, other staff members, volunteers and visitors.

Step 3. Calculate Outdoor Air Per Person

$$\frac{\text{Outdoor Air (CFM)}}{\text{Number of Occupants}} = \text{Outdoor Air (average CFM/person)}$$

- Use the equation below (the equation also appears on the Ventilation Log) to calculate average ventilation rates in CFM/ person

3. Estimating Outdoor Air Using Carbon Dioxide Measurements

Carbon dioxide (CO_2) is a normal constituent of the atmosphere. Exhaled breath from building occupants and other sources increase indoor CO_2 levels above that of the outdoor air. CO_2 should be measured with a direct-reading meter. Use the meter according to manufacturer's instructions. Indoor CO_2 concentrations can, under some test conditions, be used to access outdoor air ventilation. Comparison of peak CO_2 readings between rooms and between air handler zones may help to identify and diagnose various building ventilation deficiencies.

Step 1. Estimate quantity of outdoor air supply.

CO_2 readings, with minimal delays between readings, can be taken at supply outlets or air handlers to estimate the percentage of outdoor air in the supply airstream.

The percentage or quantity of outdoor air is calculated using CO_2 measurements as shown below.

Outdoor air (%) = (CR-CS) ÷ (CR-CO) x 100

Where: CS = ppm of CO_2 in the supply air (if measured in a room), or in the mixed air (if measured at an air handler)

CR = ppm of CO_2 in the return air

CO = PPM of CO_2 in the outdoor air (Typical range is 300-450 ppm)

All these concentrations must be measured, not assumed.

To convert the outdoor air percentage to an amount of outdoor air in cubic feet per minute, use the following calculation:

Outdoor air (CFM) = Outdoor air (percent) ÷ 100 x total airflow (CFM)

The number used for total airflow may be the air quantity supplied to a room or zone, the capacity of an air handler, or the total airflow of the HVAC system. However, the actual amount of airflow in an air handler is often different from the quantity in design documents. Therefore only measured airflow is accurate.

Step 2. Measure CO_2 levels in the area served by a given unit or exhaust fan(s) or in an area without any mechanical ventilation.

The number of occupants, time of day, position of windows and doors, and weather should be noted for each period of CO_2 testing.

- Measurements taken to evaluate the adequacy of ventilation should be made when concentrations are expected to peak. It

[illegible]

may be helpful to compare measurements taken at different times of day. Classroom CO_2 levels will typically rise during the morning, fall during the lunch period, then rise again, reaching a peak in mid-afternoon. Sample in the mid- to late-afternoon

- Take several CO_2 measurements in the area under consideration. CO_2 measurements for ventilation should be collected away from any source that could directly influence the reading (e.g., hold the sampling device away from exhaled breath)

- Take several measurements outdoors

- For systems with mechanically supplied outdoor air, take one or more readings at the following locations:

    - At the supply air vent

    - In the mixed air (if measured at an air handler)

    - In the return air

Step 3. Note whether CO_2 levels are high.

- Note locations with CO_2 concentrations of 1,000 ppm or higher. Elevated CO_2 indicates that there is not enough outdoor air for the number of people in the space (based on ASHRAE Standard 62, see **Appendix I** of the IAQ Coordinator's Guide)

- Note that there may still be underventilation problems in rooms with peak CO_2 concentrations below 1,000 PPM. CO_2 is produced by human respiration (breathing), and concentrations can change rapidly as people move in and out of a room. Four to six hours of continuous occupancy are often required for CO_2 to approach peak levels.

[redacted]

Building Maintenance Checklist

This checklist discusses seven major topics areas:

Maintenance Supplies
Dust Control
Floor Cleaning
Drain Traps
Moisture, Leaks, and Spills
Combustion Appliances
Pest Control

Instructions:

1. Read the *IAQ Backgrounder*
2. Read each item on this Checklist.
3. Check the diamond(s) as appropriate or check the circle if you need additional help with an activity
4. Return this checklist to the IAQ Coordinator and keep a copy for future reference.

Name:
Room or Area:
School:
Date Completed:
Signature:

MAINTENANCE SUPPLIES

Maintenance supplies may emit air contaminants during use and storage. Products low in emissions are preferable. However, a product that is low in emissions is not necessarily better if it is more hazardous, despite the lower emissions, if it has to be used more often or at a higher strength. Examples of maintenance supplies that may contribute to indoor air quality (IAQ) problems include:

- Caulks
- Solvents
- Paints
- Adhesives
- Sealants
- Cleaning Agents

Learn about your maintenance supplies

- Review and become familiar with your maintenance supplies
- Read labels and identify precautions regarding effects on indoor air or ventilation rate and requirements

◇ **Supplies reviewed and okay**

○ **Need help determining impact of supplies**

If you make purchase decisions, or recommend products for purchase, confirm that supplies are safe to use

- Ask vendors and manufacturers to help select the safest products available that can accomplish the job effectively

◇ **Supplies are safe to use**

○ **Need help determining if supplies are safe**

Follow good safety, handling, disposal, and storage practices

- Develop appropriate procedures and have supplies available for spill control
- Exhaust air from chemical and trash storage areas to the outdoors
- Store chemical products and supplies in sealable, clearly labeled containers
- Follow manufacturers' instructions for use of maintenance supplies
- Follow manufacturers' instructions for disposal of chemicals, chemical-containing wastes, and containers

◇ **Following good safety, handling, disposal, and storage practices**

◇ **Safety, handling, storage, and disposal practices are being revised**

○ **Need help with good safety, handling, disposal, and storage practices**

Establish maintenance practices that minimize occupant exposure to hazardous materials

- Substitute less- or non-hazardous materials where possible
- Schedule work involving odorous or hazardous chemicals for periods when the school is unoccupied
- Ventilate during and after use of odorous or hazardous chemicals

◇ **Procedures established and followed to minimize occupant exposure**

○ **Need help to develop and implement procedures to minimize occupant exposure**

DUST CONTROL

By reducing the amount of dust and dirt that enters the school, and by reducing the amount of dust that leaves vacuum bags and dust cloths, it will be possible to maintain a clean school with less effort. A cleaner school can also have positive physical and psychological effects on the students and staff. Complaints of illness and discomfort have been associated with buildings having high dust levels. In addition to dust, other particles such as pollens which can cause allergic reactions will also be reduced.

Purchase and maintain barrier floor mats for all school entrances

- Barrier mats need to be long enough to allow five full steps for people entering the school (this allows dirt to be cleaned from the mats rather than from all over the school, saving cleaning costs)
- Vacuum each barrier mat daily using a beater brush or beater bar vacuum, vacuuming in two directions (in-line and side-to-side)

◇ **Barrier mats purchased and maintained**

○ **Need help with barrier mats**

Use higher efficiency vacuum bags

- Standard paper or cloth bags allow lots of dust to pass completely through the vacuum and back into the air and onto surfaces. Use micro-filtration bags which retain dust and particles in the 3 micron size range, or smaller. Although the bags cost more, labor costs are reduced

◇ **High efficiency bags in use**

○ **Need help with obtaining proper bags**

Use proper dust wiping techniques

- Ensure that dust that has been collected remains on the wipe by using a wiping motion with a folded wipe, rather than a flicking motion with a crumpled-up wipe
- Wrap hand-held feather-type dusters with a dust cloth. Use a wiping rather than a flicking or sweeping motion

◇ **Proper dusting techniques in use**

○ **Need help with dust wiping**

Vacuum dust from heating, cooling, and ventilation air return grilles and air supply vents periodically

- In addition to vacuuming the grilles and vents using a soft bristle attachment, vacuum the ceiling and wall surfaces adjacent to the grilles and vents to remove visible dust

◇ **Dusting is performed periodically**

○ **Need help with dusting grilles and vents**

FLOOR CLEANING

All flooring, including vinyl, wood, terrazzo, tile, and carpet, requires daily attention to ensure cleanliness. In addition to the prevention technique of barrier mats as noted in previous activities, apply the following activities. Contact floor suppliers or manufacturers for recommended maintenance techniques. Follow specific guidelines of the Carpet and Rug Institute (CRI) for properly maintaining carpets (to obtain these guidelines, see information in **Appendix I**, *Resources*, in the Coordinator's Guide).

- Vacuum daily as needed for soil removal. Use a vacuum with brushes, beater bars, strong suction, and a high efficiency filter bag that will filter particles down to the 3 micron or smaller range
- Remove spots and stains immediately, using the flooring manufacturer's recommended techniques. Use care to prevent excess moisture or accumulation of cleaning residue, and ensure that cleaned areas will dry quickly

◇ **Floors are cleaned daily as needed and moisture has been removed**

○ **Need help with daily floor maintenance**

Perform restorative maintenance

- Apply the manufacturer's recommended guidelines when cleaning to remove accumulated contaminants. For carpets, CRI recommends periodic extraction cleaning, wet or dry, and complete removal of the moisture and cleaning agents

◇ **Restorative maintenance is properly performed as needed**

○ **Need help with restorative floor maintenance**

DRAIN TRAPS

Drain traps can cause IAQ problems when water in the drain trap evaporates due to infrequent use. If the building interior is under negative pressure, soil gas or sewer gas can be drawn indoors through a dry drain trap.

Confirm that all drains have drain traps

- Install traps on any untrapped drains

◇ **All drains have drain traps**

○ **Need help with traps**

Confirm that all drain traps in areas to which only you have access are filled

- Pour water down floor drains once per week (about one quart)

- Run water in sinks at least once per week (about one pint)
- Check water in seldom used toilets once each week. If low, flush

  ◇ Traps are filled at least once per week

  ○ Need help filling traps regularly

MOISTURE, LEAKS, AND SPILLS

Many people have allergic reactions to mold and mildew. Mold and mildew can grow almost anywhere that offers a food source and a small amount of moisture, whether from leaks and spills or condensation. Mold and mildew do not require standing water in order to grow. The higher the relative humidity, the higher the probability of fungal growth.

Assemble the following tools before starting the activities:

- a small floor plan for taking notes
- an instrument to measure relative humidity (e.g., sling psychrometer)

Inspect the building for signs of moisture, leaks, or spills

- Check for moldy odors
- Look for stains or discoloration on the ceiling, walls, or floor
- Check cold surfaces (e.g., locations under windows and in corners formed by exterior walls, uninsulated cold water piping)
- Check areas where moisture is generated (e.g., locker rooms, bathrooms)
- Look for signs of water damage in:
  - indoor areas in the vicinity of known roof or wall leaks
  - walls around leaky or broken windows
  - floors and ceilings under plumbing
  - duct interiors near humidifiers, cooling coils, and outdoor air intakes
- If you discover active leaks during your inspection, note their location(s) on your floor plan and repair them as quickly as possible

  ◇ There are no signs of moisture, leaks, or spills

  ○ Found signs of moisture, leaks, or spills, or need help inspecting

Respond promptly when you see signs of moisture, or when leaks or spills occur

- Clean and dry damp or wet building materials and furnishings
- Work with manufacturers of furnishings and building materials to learn recommended cleaning procedures and/or identify competent contractors who can clean damp materials
- Porous, absorbent building materials or furnishings, such as ceiling tiles, wall boards, floor coverings, etc., must be thoroughly dried and cleaned as soon as

possible. In some cases these materials might have to be disinfected. If these materials can't be dried and cleaned within 24 hours, they may have to be replaced after the cause of the moisture problem has been corrected

◇ **Moisture, leaks, or spills fixed**

○ **Need help fixing damage from moisture, leaks, or spills**

Prevent moisture condensation

There are several methods to prevent condensation:

- Reduce the potential for condensation on cold surfaces (piping, exterior walls, roof, or floor) by adding insulation. (Note: When installing insulation that has a vapor barrier, put the vapor barrier on the warm side of the insulation.)
- Raise the temperature of the air
- Improve air circulation in the problem location
- Decrease the amount of water vapor in the air
- In drier climates or winter, supply more outdoor ventilation air
- In humid climates or during humid times of the year, use a dehumidifier or desiccants to dry the air (for more information, obtain **Appendix H** from the IAQ Coordinator)
- Increase the capacity or operating schedule of existing exhaust fan(s); or add a local exhaust fan near the source of the water vapor

◇ **Moisture prevention activities completed**

◇ **Moisture prevention activities underway**

○ **Need help with moisture prevention activities**

COMBUSTION APPLIANCES

Combustion appliances are potential sources of carbon monoxide and other combustion gases. Carbon monoxide is odorless yet toxic, so it is important that appliances are properly vented to remove combustion gases. If inadequate combustion air is available to an appliance, air may be pulled, or backdrafted, down the flue, bringing combustion gases back into the indoors instead of exhausting them outside.

Note odors when first entering a location containing combustion appliances

☐ One's nose quickly becomes accustomed to odors, but upon first entering a room the smell of combustion gas odors may indicate a leak or backdrafting problem

◇ **No combustion odors**

○ **Need help resolving combustion gas problem**

Visually inspect exhaust components

☐ Inspect flue components for leaks, disconnections, and deterioration

☐ Inspect flue components for corrosion and soot

◇ **No apparent problems**

○ **Need help repairing exhaust components**

Check for backdrafting of combustion appliances

- When the combustion appliances are operating, and the building ventilation systems are in normal operating mode, use chemical smoke to determine whether air is flowing up the flue by puffing smoke near any vent openings or joints

  ◇ **No backdrafting**

  ○ **Need help resolving backdrafting problem**

PEST CONTROL

Use Integrated Pest Management (IPM) methods of pest control

☐ Do not rely on widespread, indiscriminate use of pesticides to control pests

☐ If you are in charge of pest control, obtain information about IPM from the IAQ Coordinator (information available in the Coordinator's Guide)

☐ If pesticides are used outdoors, do not apply near outdoor air intakes for the ventilation system. If unavoidable, shut down the affected ventilation system(s) and remove occupants until application has been completed and ventilation has been restored. Similarly, avoid application near doors and open windows

  ◇ **No pest problems**

  ◇ **Already using Integrated Pest Management**

  ○ **Need information or assistance with IPM**

☐ **NO PROBLEMS TO REPORT.** **I have completed all activities on this Checklist, and I do not need help in any areas.**

Food Service Checklist

This checklist discusses four major topic areas:

Cooking Area

Food Handling and Storage

Waste Management

Receiving

These activities also apply to home economics instructional areas.

Instructions:

1. Read the *IAQ Backgrounder*.
2. Read each item on this Checklist.
3. Check the diamond(s) as appropriate or check the circle if you need additional help with an activity
4. Return this checklist to the IAQ Coordinator and keep a copy for future reference.

Name:

Room or Area:

School:

Date Completed:

Signature:

COOKING AREA

Cooking activities generate odors, moisture, food waste, and other trash, all of which must be managed carefully to avoid indoor air quality (IAQ) problems. Food odors can be a distraction to students and staff if they circulate through the school.

Confirm that local exhaust fans function properly

- Check for airflow when fans are on. (Hold a piece of tissue paper near the fan to see whether it is pulled toward the fan)
- Check for cooking odors or smoke in areas adjacent to the cooking, preparation, and eating areas
- Make sure fan is not excessively noisy (excessive noise may indicate a problem or may cause the fan to not be used)

◇ **Fans function; no odors or smoke in adjacent areas**

○ **Need help, local exhaust fan does not appear to function properly**

Use exhaust fans whenever cooking, dishwashing, and cleaning.

- Make sure staff understand the importance of using the fans to prevent moisture accumulation and the spread of food odors
- Train staff to use fans when cooking, dishwashing, or cleaning
- Monitor use of fans from time to time throughout the year

◇ **Fans are used as appropriate**

○ **Need help to confirm whether fans are used appropriately**

Confirm that gas appliances function properly

- Verify that gas appliances are vented outdoors
- Check for combustion gas odors, headaches when gas appliances are in use, or natural gas odors at any time
- All gas appliances vented as appropriate

◇ **No leaks or exhaust odors**

○ **Need help checking for (or have detected problems with) leaks, odors, backdrafting, venting to outdoors**

Clean kitchen after use

- Inspect kitchen for signs of microbiological growth (check for moldy odors, slime, algae)
- Check hard-to-reach places such as the upper walls and ceiling for evidence of mold growth
- Clean affected areas as needed

- If biocides are used, select only products registered by EPA for such use, follow the manufacturer's directions for use, and pay careful attention to the method of application

◇ **No signs of microbiological growth**

○ **Need help checking for mold or cleaning**

Inspect kitchen for plumbing leaks

- Check sink faucets and area under sinks
- Look for stains or discoloration, and/or damp or wet areas

◇ **No plumbing leaks**

○ **Found leaks, need help to fix leaks**

FOOD HANDLING AND STORAGE

A clean kitchen with food stored in secure containers discourages vermin. Integrated Pest Management (IPM) practices minimize the need for pesticides and discourage pests by eliminating the food sources, pathways, and shelter they need. The IAQ Coordinator can help you and your staff learn more about IPM.

Check food preparation, cooking, and storage areas regularly for signs of insects and vermin

- Look for dead insects or rodents
- Look for vermin feces
- Notify IAQ Coordinator if insects or vermin infestation is discovered

◇ **No signs of insects or vermin**

○ **Need help, found signs of insects or vermin**

Confirm that appropriate food preparation, cooking, and storage practices are implemented

- Review food handling and storage practices. Containers should be well-sealed, with no traces of food left on outside surfaces of containers

Maintain general cleanliness

- Dispose of food scraps properly and remove crumbs
- Wipe counters clean with soap and water or a disinfectant, according to school policy
- Sweep and wet mop floors to remove food
- Clean stoves and ovens after use

◇ **Food service area is clean**

○ **Need help cleaning food service area**

WASTE MANAGEMENT

Food wastes and food-contaminated paper products produce odors and encourage insects and vermin. Proper placement of dumpsters prevents odors from entering the building and minimizes opportunities for insects and vermin to enter the building.

Place waste in appropriate containers

- Containers should have lids that close securely
- If possible, separate food waste and food-contaminated items from other wastes

◇ **Waste is stored in appropriate containers**

○ **Need appropriate containers**

Locate dumpsters well away from air intake vents, operable windows, and food service doors

◇ **Dumpster(s) properly located**

○ **Need help determining proper dumpster placement, or moving dumpster(s)**

RECEIVING

The kitchen is often the busiest part of the school for deliveries. Because fans are exhausting air from the kitchen (i.e., the kitchen is negatively pressurized), air from an adjacent loading dock may be drawn into the kitchen. If delivery trucks or other vehicles idle at the dock, exhaust fumes can be drawn in and cause problems.

Remind vendors not to idle their engines

- Post a sign prohibiting vehicles from idling their engines in receiving area
- Ask drivers to turn off their engines if they don't follow instructions on the sign

◇ **Vendors turn off engines in receiving area**

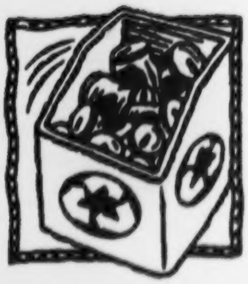
○ **Need help, vendors do not turn off engines**

Keep doors or air barriers closed between receiving area and kitchen

- Door(s) regularly closed

○ **Need help keeping door(s) closed**

☐ **NO PROBLEMS TO REPORT.** I have completed all activities on this Checklist, and I do not need help in any areas.



Waste Management Checklist

Instructions:

1. **Read the *IAQ Backgrounder.***
2. **Read each item on this Checklist.**
3. **Check the diamond(s) as appropriate or check the circle if you need additional help with an activity**
4. **Return this checklist to the IAQ Coordinator and keep a copy for future reference.**

Name:

Room or Area:

School:

Date Completed:

Signature:

WASTE MANAGEMENT

Proper waste management promotes good indoor air quality (IAQ) by controlling odors and contaminants, and is a pest management method which controls vermin. Good sanitation decreases the need for pesticides.

Select waste containers by considering the kind of waste that is placed in them

- Food waste or food-contaminated papers and plastics should be contained securely (e.g., covered containers, tied-off plastic bags) to discourage flies and other vermin
- Recycling bins should be clearly labeled so people don't put other types of trash in them
- Some materials may require special handling; for example, waste generated in art classes, science classes, and vocational/industrial education classes. Work with teachers or administrator to identify the best methods for handling special wastes

◇ **Existing waste containers are appropriate and do not need to be changed**

◇ **New waste containers appropriate to their waste are being installed**

○ **Need help to select and obtain appropriate waste containers**

Locate dumpsters away from outdoor air intakes, doors, and operable windows

- Ideally, prevailing winds should carry odors and contaminants away from the building
- Dumpsters are located away from air intakes, doors, and operable windows

◇ **Dumpsters are being moved**

○ **Need help to find appropriate location and/or move dumpsters**

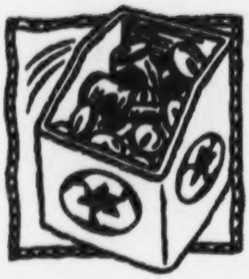
Empty waste containers regularly and frequently, and store them in an appropriate location

- Follow a regular schedule that minimizes odors and deprives vermin of their food source
- Containers that have plastic liners regularly replaced do not need to be cleaned and disinfected as often as unlined containers
- Do not store waste containers in rooms which have heating, cooling, or ventilation equipment that supplies conditioned air to other rooms

◇ **Waste containers are emptied regularly and frequently**

◇ **Waste containers are stored in an appropriate location**

○ **Need help to modify waste removal schedule**



☐ **NO PROBLEMS TO REPORT.** **I have completed all activities on this Checklist, and I do not need help in any areas.**

Renovation and Repairs Checklist

This checklist discusses seven major topic areas:

Communication
General Activities
Painting
Flooring
Roofing
Project Completion & Commissioning
Construction Administration

Instructions:

1. Read the *IAQ Backgrounder* and the information in this section.
2. Distribute appropriate portions of this checklist to groups or individuals involved in the planning process and/or actual repair/renovation work.
3. Use the checklists on pages 7-10 to limit indoor environmental hazards as repairs and/or renovations are planned and completed. Use the checklist hints to guide your observations.
4. Completed checklists should be returned to the IAQ Coordinator.

NOTE: Check EPA's web site for information on *Indoor Air Quality Tools for NEW Schools*, a comprehensive guide to new school construction with a good IAQ environment.

When planning and conducting renovations in schools, it is important to remember four potential causes of indoor air problems during renovation and repairs:

- Demolition that releases toxic materials or mold
- Construction dust and fumes
- Designs that interfere with ventilation
- Off-gassing from building materials and new products

You can minimize these problems by making good indoor air quality (IAQ) one of the criteria during project planning. Also, contract language and negotiations with service providers (contractors) can help ensure that proper materials and procedures are used, such as performing work during unoccupied periods in the school. This Renovation and Repairs Checklist is for use before and during renovation projects.

Depending on who is performing the work, you may need to give relevant sections of this Checklist to the different in-house staff or contractors involved. Instruct those who receive a portion of the Checklist to return it to the IAQ Coordinator.

See **Appendix I**, Resources, in the IAQ Coordinator's Guide, for additional sources of information on the following activities. Also see the IAQ Coordinator's Guide for suggested contract language and other useful information.

COMMUNICATION

It is important to provide advance notice and information about the project to all school occupants and parents. This helps build trust and avoid misunderstandings. Communication should include information about who will be affected,
and how (e.g., disruption of normal routines). Input into the process and expression of concerns should be encouraged. During longer projects, periodic updates should be given to keep the school community informed.

Designate an individual to provide a timely response to IAQ problems that might arise during the renovation. Ensure that emergency response plans are appropriate for the work performed. For example, if an emergency exit is blocked, an alternative must be identified. Appropriate signs should be posted to alert occupants. Projects involving asbestos and, in some states, lead, have specific regulatory requirements.

GENERAL ACTIVITIES

Plan to isolate students, staff, and other areas of the school from any dust or fumes generated during renovation work. This may include temporarily relocating people away from potential problem areas. Use plastic sheeting, portable fans, and a mechanical ventilation strategy (where applicable) to prevent dust and fumes from reaching school occupants through hallways, doors, windows, and the ventilation system (for additional details, see the activity groups on this Checklist). Also consider conducting renovation work during hours when the school is unoccupied, for example during summer "vacation" months. Even during unoccupied times, the ventilation and containment strategies mentioned above should be used to prevent the spread of contaminants through the school.

During periods of renovation, heightened housekeeping practices may be necessary, not only in the renovation area, but also in the rest of the school.

Give attention to workers and equipment leaving renovation areas to avoid carrying dust and fibers to other parts of the school. Walk-off mats, the use of removable coveralls, and wiping down equipment before exiting the work area are all effective practices.

Do not disturb asbestos during demolition. Most schools have identified and dealt with asbestos in the school under state or Federal requirements. Schools that have asbestos-containing materials, as identified in an AHERA survey, should have a management plan on file at the school. Refer to the management plan when considering whether planned renovations will require disturbing areas containing asbestos. Use an asbestos professional to consult on and assist with such renovation work. Be sure to update the AHERA management plan to reflect any asbestos abatement activities.

Test for lead-based paint before removing old paint. Use a certified inspector (if your state certifies inspectors) or a reputable testing firm for areas to be demolished, sanded, or stripped. Use appropriate personnel and precautions when removing and disposing of lead-based paint.

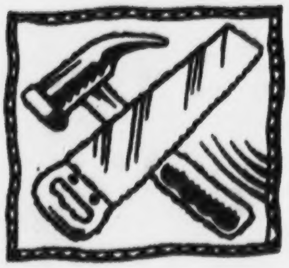
Avoid exposure to mold and bacteria. If renovation is likely to expose large areas of microbial growth such as mold and mildew (for example, while repairing water damage), consult with an environmental professional about adequate protective measures to ensure both worker and occupant safety.

Note: Even dead mold can potentially still cause allergic reactions and other health effects. (see **Appendices H & I** in the IAQ Coordinator's Guide for more information on mold).

Consider the effect of the renovation on ventilation and mixing of air in rooms. Beware of cutting off a room from its supply of outdoor air, enclosing a pollutant source (like photocopiers) in a room with inadequate exhaust or supply air, or erecting barriers, such as new walls, that could prevent adequate movement of air throughout the a room.

Minimize and provide for off-gassing from new products. New products contain volatile constituents, such as resins, solvents, and binders, which off-gas volatile organic compounds for a period of time. This process is called "off-gassing." Whenever possible, obtain information on emissions from potential new products to be installed in the school and select lower emitting products when available. Whenever new products with the potential for off-gassing are installed, allow adequate time for off-gassing before re-occupying the area, and increase ventilation with outdoor air until off-gassing odors and any irritation symptoms no longer occur. Examples of products which will potentially off-gas include:

- Wall paneling
- Draperies



- Composite wood furniture and cabinets
- Cubicle dividers
- Carpet and vinyl flooring
- Paints and finishes

PAINTING

There are many factors to consider before beginning a painting project. Special.care should be taken when sanding a surface to prepare for painting, due to the dust released into the air. The dust may contain lead particles. Exposure to excessive levels of lead could affect a child's mental growth and interfere with nervous system development, which could cause learning disabilities and impaired hearing. In adults, lead can increase blood pressure.

The type of paint is an important decision. For instance, both solvent-based and water-based paints give off volatile organic compounds (VOCs) that could lead to IAQ problems. Water-based paints produce less VOCs than solvent-based paints, but produce them over a longer period of time.

Durability is important—a relatively low-emitting paint might create more IAQ problems in the long run than a higher-emitting paint, if the low-emitting paint requires repainting more often. In addition, many water-based paints (even interior paints) have, until recently, used mercury as a fungicide. Any paint that contains mercury should not be used indoors.

Check painting records or old paint cans to determine whether the paint contains lead. Do an initial screen using a trained lead paint inspector. If there is lead in the existing paint, contact a trained lead-based paint contractor.

Evaluate existing stock of paint (properly dispose of paints containing lead or mercury or having higher VOC emissions than new paints).

Evaluate new paint before you purchase it. Express your indoor air quality concerns to paint suppliers and use their technical personnel as a resource. Not all paint suppliers have information on pollutant emissions; consult other sources (e.g., manufacturers) if your paint supplier cannot provide adequate information.

Schedule exterior painting to occur when the building is unoccupied (for example, weekends or vacation periods).

Keep nearby windows and doors closed as much as possible.

Schedule interior painting to occur when the area is unoccupied (for example, on weekends or during vacation periods), and allow time for paint odors to dissipate before occupants return to the area. *If the area being painted has a heating, cooling, and ventilation system which is shared with other areas, those areas should also be unoccupied.*

Use supply and exhaust fans to sweep paint fumes out of the building. Operate supply fans continuously (24 hours/day, 7 days/week), at the highest possible outdoor air supply setting, from the beginning of the painting work until several days after painting has been completed.

Block return openings to prevent air from circulating from the work area to occupied areas.

Seal containers carefully after use.

Keep paint containers in designated storage areas equipped with exhaust ventilation, never in heating, ventilation, and air conditioning equipment rooms.

Use an appropriate waste disposal method to dispose of any paints containing lead or mercury.

Follow EPA National Emission Standards for Hazardous Air Pollutant rules for disposal of asbestos-containing materials.

FLOORING

As is the case with other building materials and furnishings, flooring materials have the potential to impact indoor air quality; therefore selection of flooring materials is an important consideration during the renovation process. Potential pollutants from flooring materials which can impact IAQ include volatile organic compounds (VOCs) that off-gas directly from many flooring materials, and the cleaning products used to maintain the flooring. Dirty and persistently damp flooring materials can become a location for the growth of biological contaminants, such as mold. Proper cleaning and maintenance of flooring materials helps to improve IAQ.

When your school installs flooring materials, the following selection, repair, and installation activities will help protect the indoor air quality in the school.

Determine whether resilient tile flooring scheduled for removal contains asbestos fibers. Asbestos surveys conducted under AHERA may have identified asbestos-containing floor tiles. Refer to the inspection report and management plan on file at the school.

Follow notification and handling procedures defined under the National Emission Standards for Hazardous Air Pollutants (NESHAP, 40 CFR Part 61 Subpart M) if renovations will disturb asbestos-containing tile flooring.

Use low-emitting adhesives.

Follow manufacturers' recommendations for ventilating the work area.

Ask manufacturers to submit information about product constituents and emissions that may adversely impact IAQ.

The Carpet and Rug Institute (CRI) has a carpet testing and labeling program. If your carpet supplier cannot provide information on any carpets you are considering, contact CRI (800-882-8846) to obtain data on emissions from these carpets.

If practical, unwrap and unroll flooring products and cushion (if any) in a well-ventilated location prior to installation, preferably in a location other than the school, such as a ventilated warehouse.

Install carpet, vinyl, and related flooring materials only when the school building is not in use, except in the case of a small installation where you are able to exhaust the air from the space directly to the outdoors and maintain the room under negative pressure relative to the surrounding rooms and hallways.

The typical recommendation is to continuously operate the building ventilation system at normal temperature and maximum outdoor air during installation and for at least 72 hours after installation is completed. The Carpet and Rug Institute Standard for Installation of Commercial Textile Floor Covering Materials (CRI 104) addresses airing and other installation procedures for carpet.

Avoid recirculating air from the installation area through the heating, ventilation, and air conditioning system, and into occupied areas. Seal return air grilles, open doorways, stairways, and use exhaust fans to remove airborne contaminants.

Vacuum old carpet that is to be removed and subfloor surfaces (once carpet is removed) to reduce release of particles such as dirt, dust, and biological contaminants into the air and onto the new carpet.

Vacuum new flooring after installation to remove loose matter and particles generated by the installation process and general construction in the area.

Do not install carpet near water sources or areas where there is a perpetual moisture problem, i.e., by drinking fountains, classroom sinks, or concrete floors with leaks or frequent condensation.

To reduce the potential for microbial growth in the joints of hard surfaces or porous flooring installed near water sources, be sure to seal entire surface.

ROOFING

Roofing work often involves the use of tar or other pollutant-producing chemicals which may cause indoor air problems if fumes enter the building. School officials and roofers can cooperate to prevent these problems and complaints from occupants.

Schedule pollutant-producing activities for unoccupied periods (e.g., weekends or vacation periods).

Check to ensure that pollutant-producing activities occur during unoccupied periods.

Consider wind patterns at the work site, and arrange equipment so prevailing winds carry odors away from the building.

Modify ventilation to avoid introducing odors and contaminants.

Advise staff and students to keep doors and windows closed until the roofing work is finished.

It may be advisable to temporarily close the outdoor air intakes of air handlers; particularly rooftop units in the vicinity of (and downwind from) the work area. (NOTE: To avoid creating IAQ problems from under-ventilation, provide a temporary means [fans and/or ducts] to supply unaffected outdoor air, and reduce pollutant generating activities indoors.)

PROJECT COMPLETION & COMMISSIONING

You should establish IAQ-related procedures and criteria that must be met at the completion of any renovation project. These criteria should address the state in which the school should be in when the project is finished and the last worker leaves. Areas that should be covered include:

- General cleaning, including the wet wiping of surfaces and vacuuming (high efficiency vacuuming for fine or potentially toxic dusts, such as asbestos, lead or mold)
- Cleaning building system components, including those in the ventilation system which have been contaminated during the work. This includes the disposal and replacement of filters
- Balancing and testing the ventilation system if it has been modified, or if areas served by the ventilation system have been altered (e.g., if a partition wall was installed or removed)

CONSTRUCTION ADMINISTRATION

Schools should include contract specifications which reflect the recommendations in this information and checklist. Oversight should be used to ensure the specifications are being met. Possible contract specification topics include:

- Notification and communication
- Scheduling to minimize occupant exposure
- Selection of building materials
- Protection of building systems and furnishings, including the ventilation system
- Use of isolation techniques, including barriers and negative pressure
- Ventilation and filtration requirements
- Work practices and housekeeping
- Material storage
- Close-out and commissioning criteria

Renovation and Repairs Checklist

GENERAL ACTIVITIES

Pre-Renovation

☐ Notify school occupants and parents.

☐ Consult asbestos (AHERA) survey.

☐ Test for lead-based paint before removing old paint.

Plan isolation strategy for:

☐ Students and staff.

☐ Non-work areas of building.

☐ Ventilation system.

☐ Arrange for increased housekeeping activities.

☐ Consider ventilation implications, supply and exhaust for all affected rooms, in and out of work area.

☐ Select products to minimize off-gassing.

☐ Put IAQ-related specifications in construction contracts.

☐ Evaluate work area for signs of potential hidden mold before starting destructive activities. Signs include must or moldy odors, visible water damage, or a history of leaks in the area.

During Renovation

☐ Progress reports made to school occupants and parents for longer projects.

☐ If asbestos will be disturbed, use an asbestos professional.

☐ Avoid exposure to mold and bacteria. For large areas of contamination, consult with an environmental professional about protective measures and special close-out procedures.

☐ Implement isolation plan.

☐ Verify that housekeeping activities are sufficient to control dirt and dust.

☐ Verify that contract specifications are being adhered to.

Close-out

☐ Clean surfaces with wet-wiping and vacuuming (high efficiency vacuuming for fine or potentially toxic dusts, such as lead, asbestos, or molds).

☐ Clean building system components as needed.

☐ Ventilation system filters changed.

☐ If HVAC system has been modified, or if rooms served by system have been altered, balance and test HVAC system.

☐ I have completed the activities on the Renovation and Repairs Checklist, and I do not need help in any areas.

Name:

School:______

Room or Area:

Date Completed:

Signature:

Renovation and Repairs Checklist

PAINTING

Pre-Renovation

☐ Confirm that the painted surface is lead-free before preparing a surface for repainting.

○ **Paint contains lead or testing is needed to determine if lead is in existing paint.**

☐ Select a low-VOC emitting paint that is free of lead and mercury.

☐ Schedule painting to occur when building is unoccupied, if possible.

☐ I have completed the activities on the Renovation and Repairs Checklist, and I do not need help in any areas.

Name:

School:______

Room or Area:

Date Completed:

Signature:

During Renovation

☐ Minimize occupant exposure to odors and contaminants.

☐ Use exhaust and supply ventilation to sweep fumes out of building.

☐ Block ventilation return openings to prevent circulating air from the work area to other areas of the building.

☐ Use proper storage and disposal practices for paints, solvents, and supplies. Keep container lids sealed when not in use.

Close-Out

☐ Allow paint odors to dissipate before occupants return to the area.

☐ Use supply and exhaust fans to sweep fumes out of the building. Operate supply fans continuously at the highest possible outdoor air supply setting until several days after the painting has been completed.

☐ Use appropriate storage and disposal practices for paints, solvents, and clean-up materials. Keep container lids sealed when not in use.

☐ Use an appropriate waste disposal method to dispose of any old paints containing lead or mercury.

☐ Follow EPA National Emission Standards for Hazardous Air Pollutants rules for disposal of asbestos-containing materials.

○ **Need help with storage and disposal.**

Renovation and Repairs Checklist

FLOORING

Pre-Installation

- ☐ Determine whether resilient tile flooring scheduled for removal contains asbestos fibers.

  ○ **Renovation may/will disturb asbestos-containing flooring.**

- ☐ Select low-emitting adhesive when installing glue-down flooring.
- ☐ Obtain information about product constituents and emissions that may adversely impact IAQ from manufacturers.
- ☐ Select a low-emitting adhesive.
- ☐ Select low-emitting flooring materials.

  ○ **Need additional information for selecting low-emitting adhesive and flooring materials.**

- ☐ Do not install carpet near water sources.
- ☐ When possible, schedule installation for time when school is unoccupied.

[illegible]

During Installation

- ☐ Use low-emitting adhesives.
- ☐ Use low-emitting flooring materials.
- ☐ Air out new products before installation.

  ○ **Need help arranging the airing out of flooring products.**

- ☐ Follow manufacturers' recommendations for ventilating the work area during and after flooring installation.
- ☐ Install carpet, vinyl, and related flooring materials only when the school building is not in use or maintain the room under negative pressure relative to the surrounding rooms and hallways.
- ☐ Avoid recirculating air from the installation area, through the heating, ventilation, and air conditioning system, and into occupied areas. Seal return air grilles, open door ways, stairways, and use exhaust fans to remove airborne contaminants.

  ○ **Need help arranging the airing out of space during and after installation.**

- ☐ Vacuum old carpet that is to be removed and subfloor surfaces (once carpet is removed).
- ☐ Seal joints of hard surfaces and/or entire surface of porous flooring installed near water sources.

Post-Installation

- ☐ Vacuum new flooring after installation to remove loose matter and particles generated by the installation process and general construction in the area.
- ☐ Follow manufacturers' recommendations for ventilating the work area space during and after flooring installation. (Typical recommendation is maximum outdoor air for 72 hours after installation.)

☐ I have completed the activities on the Renovation and Repairs Checklist, and I do not need help in any areas.

Name:

School:______

Room or Area:

Date Completed:

Signature:

Renovation and Repairs Checklist

ROOFING

Pre-Renovation

☐ Schedule pollutant-producing activities for unoccupied periods (e.g., weekends or vacation periods).

○ **Need help to minimize occupant exposure**

During Renovation

☐ Put "hot pots" of tar and other pollutant-producing materials away from outdoor air intakes.

☐ Consider wind patterns at the work site, and arrange equipment so prevailing winds carry odors away from the building.

○ **There is not a good location for pollutant-producing materials during this renovation**

☐ Modify ventilation to avoid introducing odors and contaminants.

☐ Advise staff and students to keep doors and windows closed until the roofing work is finished.

☐ It may be advisable to temporarily close the outdoor air intakes of air handlers, particularly rooftop units in the vicinity of (and downwind from) the work area. (NOTE: To avoid creating IAQ problems from under-ventilation, provide a temporary means [fans and/or ducts] to supply unaffected outdoor air, and reduce pollutant generating activities indoors).

○ **Need help to modify ventilation**

☐ **I have completed the activities on the Renovation and Repair Checklist, and I do not need help in any areas.**

Name:

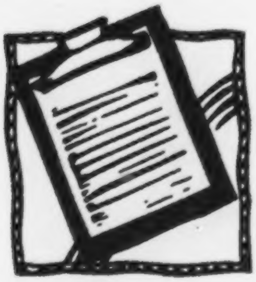
School:______

Room or Area:

Date Completed:

Signature:

Walkthrough Checklist



This checklist is to aid during an IAQ Walkthrough of the school. The checklist includes considerations both inside and outside the school building:

Instructions:

1. Read the *IAQ Backgrounder* and the information in this section.
2. For each area use the checklist hints to guide your observations. Note any obvious potential problems, including description and location. Use additional paper if necessary.
3. Return the checklist to the IAQ Coordinator and keep a copy for future reference.

Name:

Room or Area:

School:

Date Completed:

Signature:

The Walkthrough Inspection is not intended to be an intensive, detailed, or costly inspection, but rather a quick overview of the conditions that affect the quality of air within your school. You may wish to have someone who is familiar with the operation of the building, such as a facility operator or custodian, assist you during the inspection. The Walkthrough Inspection is part of the IAQ Management Plan. While some schools wait until the initial parts of the Plan have been completed, some schools have had success "jump-starting" their program by beginning with a quick walkthrough and taking immediate action where the potential problems are obvious and easy to correct.

During your walkthrough inspection, you can learn a lot by using your sense of sight, smell, feeling, and hearing to gain information on factors which affect indoor air quality. You may even be able to make immediate corrections!

Observe the general level of cleanliness in classrooms and mechanical rooms. Look for pollutant sources such as mold, improperly stored chemicals, or excessively dirty air filters and ducts. Look for signs of water damage which may point to an underlying problem which increases the chance of biological contaminants. And look for blocked airflows such as those caused by books or papers on top of unit ventilators or plywood covering outdoor air intakes.

Smell for unique or objectionable odors—including mold, mildew, and "chemical" smells—as you move from room to room. Note any potential sources of these odors.

Feel for uncomfortable air temperatures, drafts, and high or low humidity, and feel for air flowing into and out of grilles and air vents.

Listen to the concerns of school occupants regarding IAQ. Do they provide clues to problems such as using their own pest spray to control pests, or turning off the unit ventilator because it is too noisy during class-time? Do you hear unusual equipment noises which may indicate potential problems, and do you hear air blowing out of supply vents?

Do a walkthrough inspection in all special-use areas, such as the cafeteria, art rooms, and industrial arts areas.

EXTERIOR INSPECTION

Begin the walkthrough inspection outside. You are looking for anything which might impact the air indoors. Considerations include ventilation inlets, outdoor sources of pollution such as vehicle exhaust or pesticides, site drainage, holes in the building shell, and evidence of pests. Use the checklist to guide your inspection, and note any relevant observations on this sheet or on a plan of the school.

GROUND LEVEL **Location/Observation**

- Ventilation units on and air flowing into outdoor air intakes? (See Ventilation Checklist for more information.)
- Outdoor air intakes free from blockage or obstruction (boards, leaves, vegetation, snow, etc.)?
- No bird or animal nests or droppings near outdoor air intakes?
- No garbage dumpsters located near doors, windows, or outdoor air intakes?
- No painting, roofing, or maintenance of the exterior of the building in the vicinity of outdoor air intakes?
- No potential sources of air contaminants in the vicinity of the building (chimneys, stacks, industrial plants, exhaust from nearby buildings)?
- No vehicle engines (auto, truck, or bus) exhaust near outdoor air intakes? Vehicles left idling when parked at loading zones or docks?
- No exterior pesticide application?
- Roof downspouts and scuppers drain water away from the building?
- Good site drainage away from building?
- Sprinklers do not water excessively near building, or over-spray onto building or into outdoor air intakes, etc.?
- Clean walk-off mats at every exterior entrance?

ROOF

Location/Observation

- !! **While on the roof, consider performing inspection of HVAC units (use *Ventilation Log*)**
- ● Roof in good repair?
- ● Evidence of ponding?
- ● Ventilation units on and air flowing into outdoor air intakes? (See Ventilation Checklist for more information.)
- ● Outdoor air intakes open, even at the minimum setting? (See Ventilation Checklist for more information.)
- ● Bird or animal nests or droppings near outdoor air intakes?
- ● Plumbing stacks 10 feet away from outdoor air intakes?
- ● Exhaust fans operating and air flowing out?
- ● Any exhaust air outlets within 10 feet of outdoor air intakes?

ATTIC

Location/Observation

- ● Evidence of roof or plumbing leaks?
- ● Bird or animal nests?

INTERIOR INSPECTION

Continue the walkthrough inspection inside. You are looking for noticeable temperature & humidity concerns, indications that the ventilation system is functioning, general cleanliness, evidence of pollutant sources including mold and mildew, anything which might impact the air indoors. Use the checklist to guide your inspection, and note any relevant observations on this sheet or on a floor plan of the school.

GENERAL CONSIDERATIONS IN CLASSROOMS AND OTHER AREAS

Location/Observation

- Are temperature and humidity within acceptable ranges?
- Is air flowing into and out of the room as designed?
- Are supply and exhaust vents free from blockage or obstruction?
- Area free of objectionable odors?
- No signs of mold or mildew growth?
- No signs of unresolved or ongoing water damage?
- Is the area generally clean and dust under control?
- Area free of evidence of pests or obvious food sources or entryways?
- Do the room occupants report any concerns or problems?

BATHROOMS AND GENERAL PLUMBING

Location/Observation

- Bathrooms and restrooms have operating exhaust fans?
- All drains have traps?
- Drain traps are filled with water (floor drains, sinks, toilets)?

MAINTENANCE SUPPLIES

Location/Observation

- Odorous or hazardous chemicals used with adequate ventilation and only when building is unoccupied?
- Air exhausted from chemical (e.g., custodial closets) and trash storage areas?

[redacted]

COMBUSTION APPLIANCES

Location/Observation

- Combustion gas or fuel odors ever detected?
- Combustion appliances have flues (e.g., furnaces, boilers, water heaters) or exhaust hoods (e.g., kitchen ranges, kilns)?
- Flue components free from leaks, disconnections, deterioration, or soot?
- Soot on outside of flue components?

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OTHER

Location/Observation

- If the building was built before 1980, is paint inside or outside free from peeling or flaking? [lead paint hazard]
- Have radon measurements been performed in the school?

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